STORMWATER DRAINAGE REPORT

BEL'S WAY

A ESIDENTIAL DEVELOPMENT

24 NEW BOSTON ROAD
NEWTON, NH

DECEMBER 2023

by

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INTRODUCTION

The purpose of this analysis is to evaluate the impact of proposed site development on abutting properties and an existing wetland resource area in Newton, NH. Development is proposed on a portion of a 18.4 acre lot, known as Tax Map 3, Block 1, Lot 12, located on north side of Thornell Road. This lot along with the construction of an access road for the creating six new single-family homes, associated utilities, infiltration basin, swales and required grading is proposed. There will be seven total house lots

All construction activities are proposed on hydrologic group B & C soils, well and moderately well drained glaciofluvial and glacial till soil. There are some surface boulders and no restrictive features as determined by the high intensity soil survey. The vegetated cover is currently woodland (recent timber harvest) with good hydrologic conditions, and undisturbed vegetated grade. The proposed access roadway has ample sight distance in each direction exiting the site.

Currently runoff from the site flows mostly south overland into a large wetland resource area that is owned by the Town. A small portion of the site drains toward New Boston Road then flows along with the road runoff to an existing road crossing culvert westerly of the property

Runoff from most of the impervious roadway surface will flow by roadside swales to a Detention Basin. An outlet control structure will mitigate the increased rate of runoff and allow the runoff the then flow by a long treatment swale to the wetlands at south side of the property. Excess runoff from the other portions of the development will flow overland into the same wetland area, the point of analysis for the storm water runoff flows.

This analysis utilizes field measurements, site specific topographic mapping, site specific HISS mapping, information from topographic and soil maps, and uses a simple procedure developed by the USDA Soil Conservation Service to estimate existing and proposed stormwater runoff in the area of this development. The intent is to model stormwater runoff and compare the post development runoff with pre development runoff. There should be no significant impact offsite as a result of this development.

METHODOLOGY

The drainage analysis performed utilizes nationally recognized techniques developed by the USDA, Soil Conservation Service (SCS). The techniques and models used for this analysis are described in "Urban Hydrology for Small Watersheds, Technical Release Number 55" dated 1986.

Design computations were based on a type III storm events – as recommended for Rockingham County. A 2, 10, 25 50 & 100-year – 24-hour events of 3.17, 4.86, 6.19, 7.45 &8.97 inches of precipitation were analyzed. The following model does not consider runoff from snowmelt or rain on frozen ground. Pre and post-development conditions were analyzed by the same method. However, the size and number of predevelopment sub-catchment areas differed from the post development sub-catchment areas because of the alteration of drainage patterns resulting from the proposed site layout and construction of the roadway and related grading. Calculations were conducted using the computer program "HydroCAD® Stormwater Modeling System, Version 9.1". A tabulated summary of the results is shown following the "PROCEDURE".

PROCEDURE

Predevelopment Analysis

To begin the analysis, the limit of the watershed area was identified. This area is shown on the "Predevelopment Watershed Map". Weighted runoff curve number (CN) is calculated for area. Runoff curve numbers are values chosen based on site investigation, TR-55 standards and by the High Intensity Soil Survey performed by the project Soil Scientist. The value of CN depends on soil type, vegetative cover and hydraulic conditions of the land surface, surface water run off rate and total volume during and after a storm event is also influenced by:

a. Slope of land
b. Area of watershed
c. Hydraulic length of watershed
d. Ponds and swamps

In addition, the amount of surface runoff produced by a given storm event is a function of the duration and intensity of the storm.
Within each sub-watershed, a line of longest hydraulic length is drawn and scaled from the topographic plan. This line and slope are used to compute the time of concentration (Tc) of runoff. Using this information, computer generated hydrographs were calculated and peak runoff determined for each storm.

Post development Analysis

Because all development increases peak flow runoff, the design must incorporate control devices to mitigate the increased runoff. Swales, culverts, catch basins, treatment swale and detention basin were used on this project to control peak flow and treat runoff.
The catch basins with sumps, will capture sediments from a small portion of the proposed pavement runoff and some from the edge of New Boston Road.
The size and design of these devices are used as input data for post development routing by the computer program. Also, lot development runoff values for sheet flow and shallow concentrated flow over grass are used to determine that surface runoff to the wetlands. The result shows peak flow to wetland which fulfills the design intent. The results are shown in Appendix B. Details and supporting data are also provided at the end of the calculations.

SUMMARY OF RESULTS

PEAK RATE OF RUNOFF TO POA1					
	2-YR	10YR	25YR	50YR	100YR
PRE	2.58	7.05	11.1	15.17	20.26
POST	2.83	7.02	10.72	14.39	18.92
change	0.25	-0.03	-0.38	-0.78	-1.34
PEAK RATE OF RUNOFF TO POA2					
	2-YR	10YR	25YR	50YR	100YR
PRE	1.14	4.85	8.7	12.78	18.08
POST	1.12	4.69	8.70	12.56	17.89
change	-0.02	-0.16	0.00	-0.22	-0.19
PEAK RATE OF RUNOFF TO POA3					
	2-YR	10YR	25YR	50YR	100YR
PRE	3.15	9.55	15.6	21.78	29.60
POST	3.28	9.55	15.39	21.33	28.83
change	0.13	0.00	-0.21	-0.45	-0.77

CONCLUSIONS

The results show reduced peak rate of runoff for each major storm event. For the small storm events the runoff rate is equal or slightly over pre development conditions. With leaves and sticks reducing the flow, I presume the rate may be lower the pre. For all other rainstorm events the rate of runoff is reduced with this design for development. Therefore, no impact downstream as a result of development. These variations are not significant enough to affect wetland hydrology.

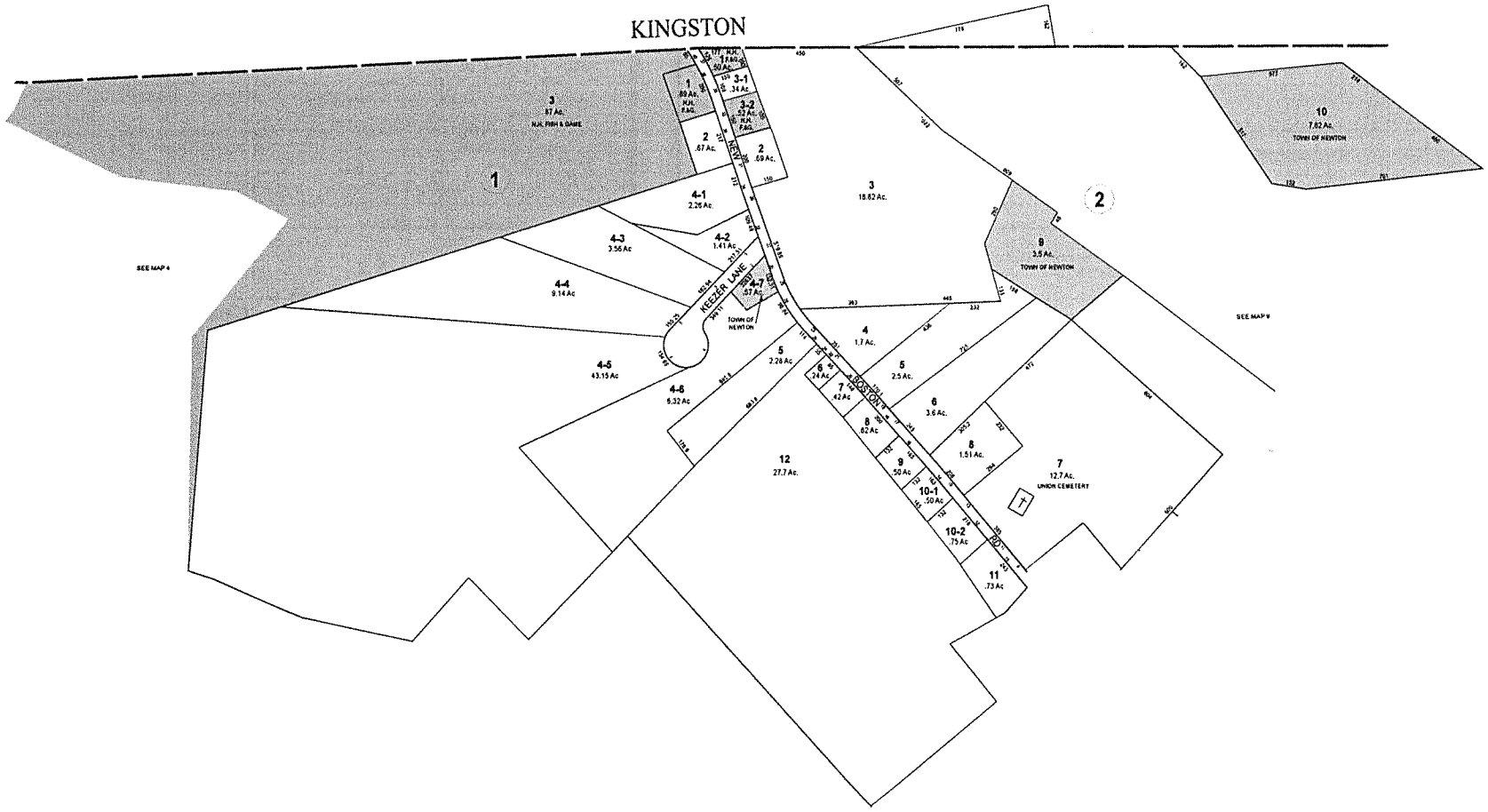
The intent of the storm water management methods employed in this design are to maintain water quality and minimize the downstream impact from development. By implementing the design shown on the Plan, Detail sheets and proper use of "Best Management Practices" (BMP's), water quality can be maintained during construction. Also, by limiting flow rates, as near as possible to the current flow rates, downstream flooding and erosion can be prevented.

SEDIMENT AND EROSION CONTROL PLAN

Standard BMP's shall be utilized to account for any adverse erosion and sedimentation problems during construction process. Filter sock shall be installed and maintained (see Grading & Drainage Plans) along the downhill side of all excavation and any material stockpile areas to prevent transfer of sediments from the construction zone to wetlands or offsite. All disturbed areas shall be stabilized and re-vegetated as soon as possible. If fill or topsoil piles are exposed for longer than 30 days, they shall be mulched with hay. As with all new impervious surfaces, stormwater runoff is directed from sheet flow to channel flow. When possible, the swales shall be constructed to direct the water to temporary level spreaders. The level spreaders will transfer the surface channel flow back to sheet flow. Stone check dams shall be placed in all temporary or permanent drainage swales to prevent soil erosion and sediment transport.

All BMP devices shall be monitored and modified, as needed, by the owner or his contractor during the construction process and until all disturbed areas are completely stabilized. It is their responsibility to employ all storm water management methods necessary to control surface runoff and minimize soil erosion. The goal is to maintain downstream wetland resource characteristics and preserve surface and subsurface water quality.

Since the area of disturbance for this proposed project is less than 100,000 SF, an Alteration of Terrain (Site Specific) Permit will not be required for this project.



REVISED & REPRINTED BY
CAI Technologies
Precision Mapping, Geospatial Solutions

LEGEND

BLOCK NUMBER 5
LOT NUMBER 5
SUBDIVISION LOT NUMBER ..... (5)
WATER .....
CONSERVATION EASEMENT .....
COMMON LAND .....
TOWN OF NEWTON .....
STATE OF NH .....

SCALE: 1" = 200'

FEET 200 100 0 200 400 600
METERS 50 25 0 50 100 150

REVISED TO: APRIL 1, 2021

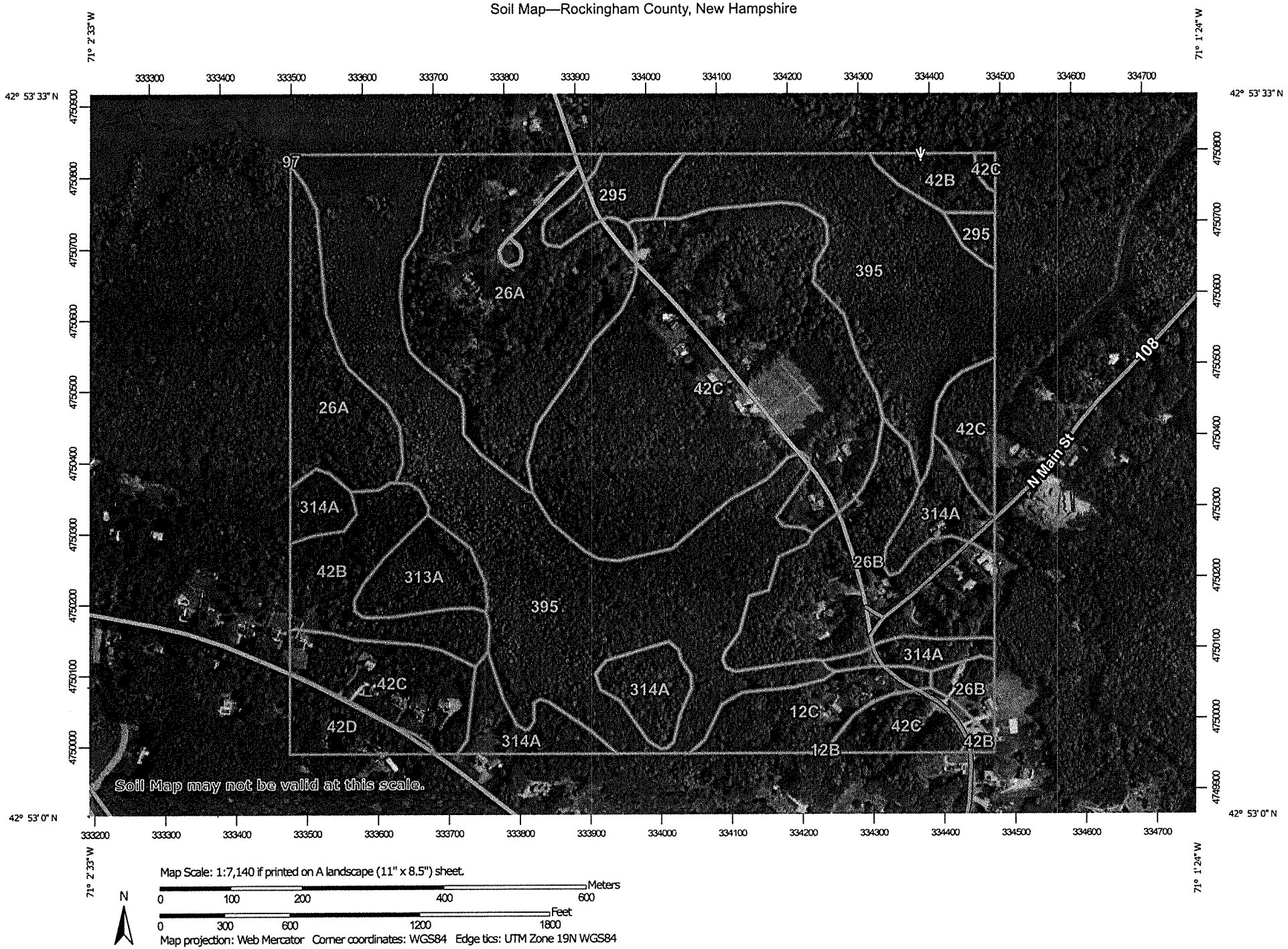
PROPERTY MAPS

NEWTON

NEW HAMPSHIRE

INDEX DIAGRAM

MAP NO. 3


71° 2' 33" W
71° 1' 24" W
42° 53' 33" N
42° 53' 0" N
333300
333400
333500
333600
333700
333800
333900
334000
334100
334200
334300
334400
334500
334600
334700
4750900
4750800
4750700
4750600
4750500
4750400
4750300
4750200
4750100
4750000
4749900
97
295
42B
42C
26A
395
108
N Main St
313A
314A
26B
12C
12B
42D
Soil Map may not be valid at this scale.
Map Scale: 1:7,140 if printed on A landscape (11" x 8.5") sheet.
Meters
0
100
200
400
600
Feet
0
300
600
1200
1800
N
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Rockingham County, New Hampshire
Survey Area Data: Version 26, Aug 22, 2023

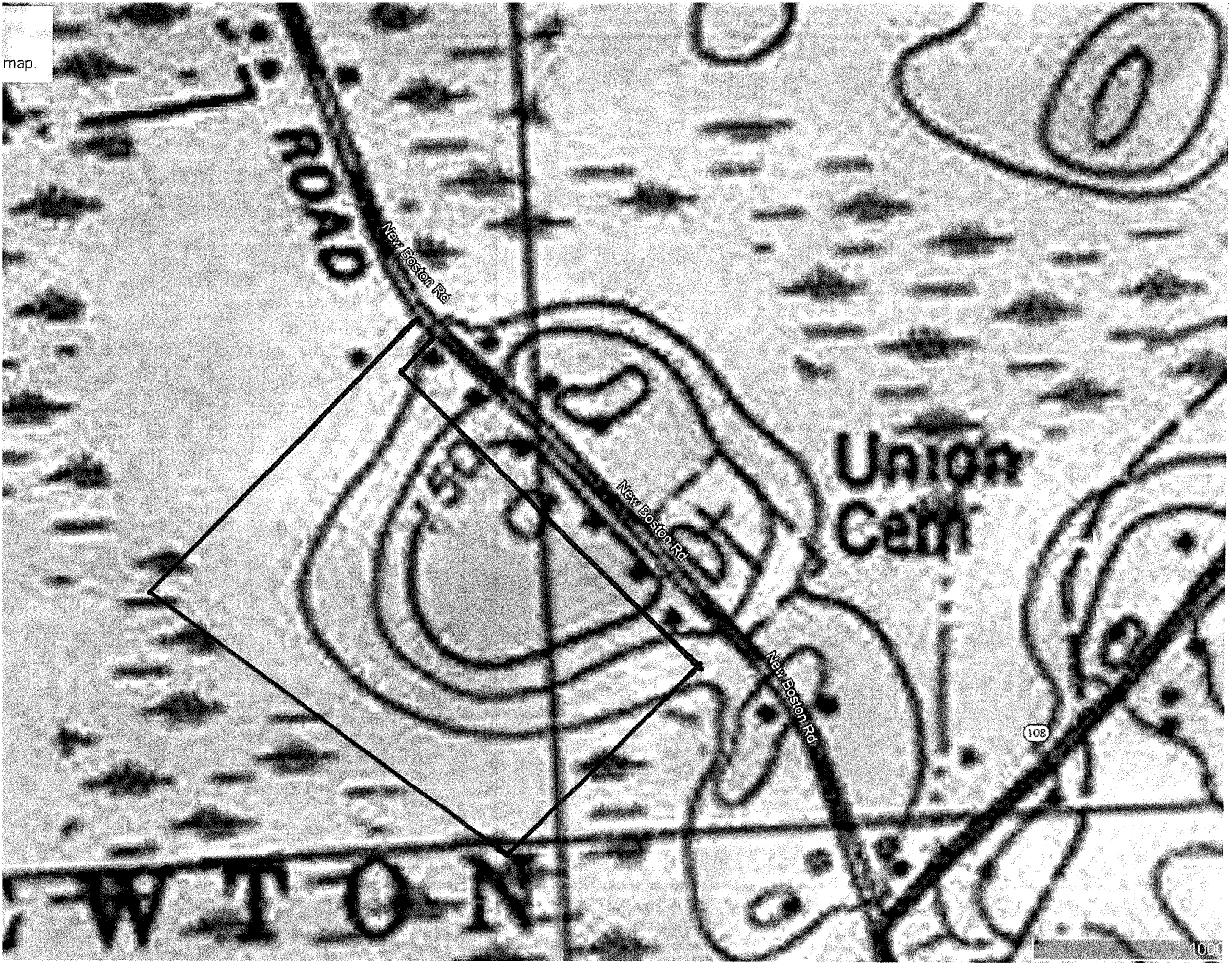
Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 22, 2022—Jun 5, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
12B	Hinckley loamy sand, 3 to 8 percent slopes	0.0	0.0%
12C	Hinckley loamy sand, 8 to 15 percent slopes	5.5	2.6%
26A	Windsor loamy sand, 0 to 3 percent slopes	32.6	15.7%
26B	Windsor loamy sand, 3 to 8 percent slopes	16.9	8.1%
42B	Canton fine sandy loam, 3 to 8 percent slopes	10.7	5.1%
42C	Canton fine sandy loam, 8 to 15 percent slopes	55.3	26.6%
42D	Canton gravelly fine sandy loam, 15 to 25 percent slopes	3.2	1.5%
97	Freetown and Natchaug mucky peats, ponded, 0 to 2 percent slopes	0.0	0.0%
295	Freetown mucky peat, 0 to 2 percent slopes	4.1	2.0%
313A	Deerfield loamy fine sand, 0 to 3 percent slopes	4.3	2.0%
314A	Pipestone sand, 0 to 5 percent slopes	13.2	6.3%
395	Swansea mucky peat, 0 to 2 percent slopes	62.4	30.0%
Totals for Area of Interest		**208.1**	**100.0%**


ROAD
New Boston Rd
New Boston Rd
New Boston Rd
Union
Cem
108
WILTON

map.

Extreme Precipitation Tables

Northeast Regional Climate Center

Data represents point estimates calculated from partial duration series. All precipitation amounts are displayed in inches.

Metadata for Point

Smoothing	Yes
State	
Location	
Latitude	42.888 degrees North
Longitude	71.033 degrees West
Elevation	40 feet
Date/Time	Mon Oct 16 2023 16:17:32 GMT-0400 (Eastern Daylight Time)

Extreme Precipitation Estimates

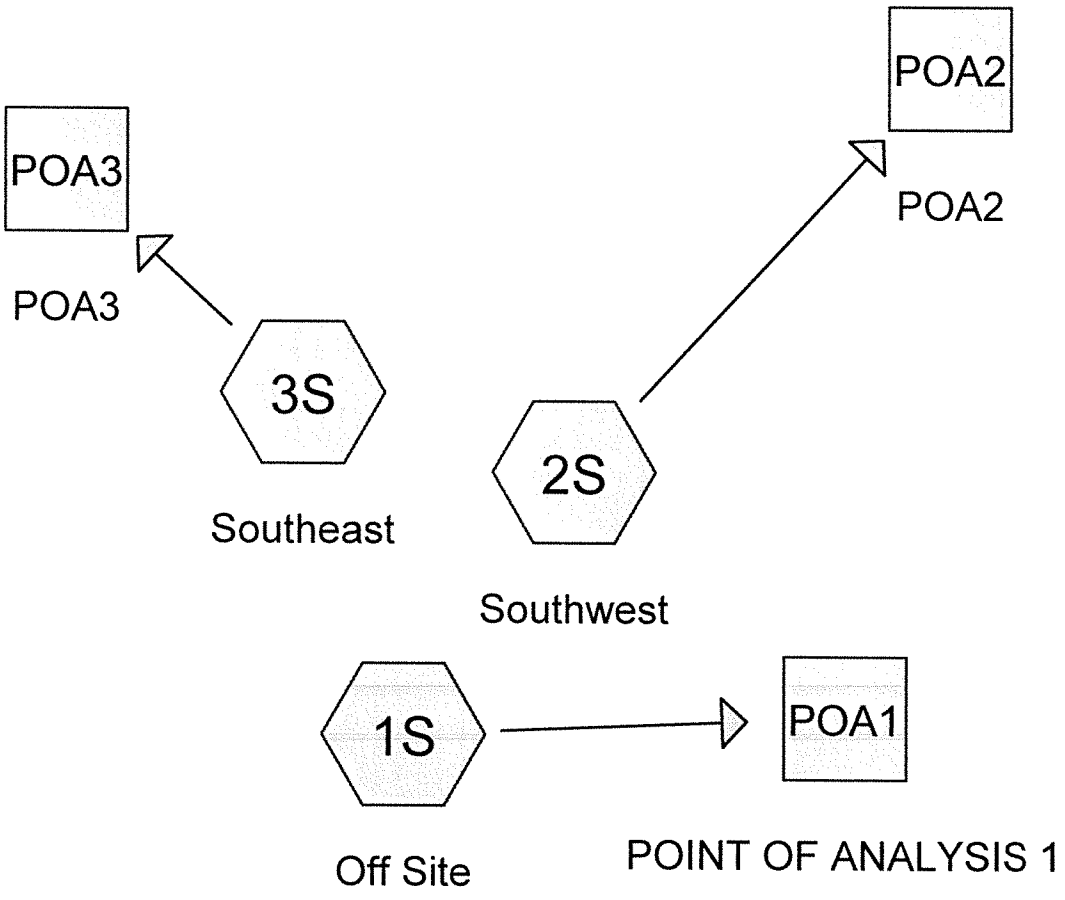
	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.27	0.41	0.51	0.66	0.83	1.05	**1yr**	0.72	0.99	1.23	1.58	2.04	2.65	2.86	**1yr**	2.35	2.75	3.17	3.86	4.50	**1yr**
2yr	0.33	0.50	0.63	0.82	1.03	1.31	**2yr**	0.89	1.19	1.53	1.94	2.48	3.17	3.52	**2yr**	2.81	3.39	3.90	4.62	5.27	**2yr**
5yr	0.38	0.60	0.75	1.00	1.28	1.64	**5yr**	1.11	1.49	1.92	2.46	3.15	4.04	4.53	**5yr**	3.58	4.35	4.99	5.92	6.68	**5yr**
10yr	0.43	0.67	0.85	1.16	1.50	1.95	**10yr**	1.30	1.77	2.29	2.95	3.79	4.86	5.48	**10yr**	4.30	5.27	6.01	7.15	8.00	**10yr**
25yr	0.50	0.80	1.02	1.40	1.86	2.44	**25yr**	1.61	2.21	2.89	3.74	4.82	6.19	7.06	**25yr**	5.48	6.79	7.69	9.18	10.16	**25yr**
50yr	0.56	0.90	1.16	1.62	2.20	2.91	**50yr**	1.89	2.62	3.46	4.50	5.81	7.45	8.56	**50yr**	6.60	8.23	9.27	11.10	12.17	**50yr**
100yr	0.64	1.04	1.34	1.90	2.59	3.46	**100yr**	2.23	3.10	4.12	5.38	6.97	8.97	10.37	**100yr**	7.94	9.97	11.17	13.43	14.60	**100yr**
200yr	0.73	1.19	1.55	2.21	3.05	4.11	**200yr**	2.63	3.68	4.92	6.44	8.36	10.79	12.57	**200yr**	9.55	12.09	13.48	16.26	17.52	**200yr**
500yr	0.87	1.43	1.87	2.71	3.80	5.17	**500yr**	3.28	4.62	6.22	8.19	10.67	13.80	16.22	**500yr**	12.21	15.60	17.27	20.95	22.31	**500yr**

Lower Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.24	0.37	0.45	0.61	0.75	0.88	**1yr**	0.64	0.86	1.01	1.26	1.54	2.38	2.60	**1yr**	2.11	2.50	2.93	3.58	4.09	**1yr**
2yr	0.32	0.49	0.60	0.82	1.01	1.20	**2yr**	0.87	1.17	1.37	1.81	2.31	3.09	3.42	**2yr**	2.74	3.29	3.80	4.48	5.13	**2yr**
5yr	0.36	0.56	0.69	0.95	1.21	1.43	**5yr**	1.05	1.40	1.62	2.10	2.70	3.73	4.16	**5yr**	3.30	4.00	4.60	5.56	6.19	**5yr**
10yr	0.40	0.62	0.77	1.07	1.39	1.65	**10yr**	1.20	1.61	1.83	2.38	3.03	4.29	4.82	**10yr**	3.80	4.63	5.33	6.53	7.08	**10yr**
25yr	0.47	0.71	0.88	1.26	1.66	1.97	**25yr**	1.43	1.93	2.14	2.75	3.53	5.13	5.84	**25yr**	4.54	5.61	6.45	8.06	8.87	**25yr**
50yr	0.52	0.79	0.98	1.42	1.91	2.27	**50yr**	1.64	2.22	2.40	3.08	3.96	5.87	6.73	**50yr**	5.19	6.47	7.45	9.48	10.27	**50yr**
100yr	0.59	0.89	1.11	1.60	2.20	2.61	**100yr**	1.90	2.55	2.69	3.45	4.43	6.69	7.75	**100yr**	5.92	7.45	8.61	11.15	11.89	**100yr**
200yr	0.66	0.99	1.25	1.81	2.53	3.00	**200yr**	2.18	2.93	3.02	3.85	4.96	7.61	9.89	**200yr**	6.74	9.51	9.95	13.13	13.78	**200yr**
500yr	0.77	1.15	1.48	2.15	3.06	3.62	**500yr**	2.64	3.54	3.51	4.45	5.77	8.98	12.23	**500yr**	7.94	11.76	12.06	16.32	16.73	**500yr**

Upper Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.29	0.45	0.54	0.73	0.90	1.08	**1yr**	0.78	1.06	1.27	1.68	2.13	2.88	3.14	**1yr**	2.55	3.02	3.45	4.12	4.85	**1yr**



Subcat Reach Pond Link

Drainage Diagram for Pre

Prepared by Civil Construction Management, Inc., Printed 12/14/2023

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
8.506	55	Woods, Good, HSG B (1S, 2S, 3S)
10.964	70	Woods, Good, HSG C (1S, 2S, 3S)
1.044	74	>75% Grass cover, Good, HSG C (1S)
0.097	98	Roofs, HSG C (1S)
0.373	98	Unconnected pavement, HSG C (1S)
20.984		**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
8.506	HSG B	1S, 2S, 3S
12.478	HSG C	1S, 2S, 3S
0.000	HSG D	
0.000	Other	
20.984		**TOTAL AREA**

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Off Site Runoff Area=171,773 sf 11.91% Impervious Runoff Depth>0.68"
Flow Length=758' Tc=10.8 min UI Adjusted CN=69 Runoff=2.58 cfs 0.225 af

Subcatchment 2S: Southwest Runoff Area=325,044 sf 0.00% Impervious Runoff Depth>0.34"
Flow Length=1,032' Tc=36.9 min CN=60 Runoff=1.14 cfs 0.210 af

Subcatchment 3S: Southeast Runoff Area=417,243 sf 0.00% Impervious Runoff Depth>0.55"
Flow Length=741' Tc=32.1 min CN=66 Runoff=3.15 cfs 0.440 af

Reach POA1: POINT OF ANALYSIS 1 Inflow=2.58 cfs 0.225 af
Outflow=2.58 cfs 0.225 af

Reach POA2: POA2 Inflow=1.14 cfs 0.210 af
Outflow=1.14 cfs 0.210 af

Reach POA3: POA3 Inflow=3.15 cfs 0.440 af
Outflow=3.15 cfs 0.440 af

Total Runoff Area = 20.984 ac Runoff Volume = 0.875 af Average Runoff Depth = 0.50"
97.76% Pervious = 20.514 ac 2.24% Impervious = 0.470 ac

Summary for Subcatchment 1S: Off Site

Runoff = 2.58 cfs @ 12.17 hrs, Volume= 0.225 af, Depth> 0.68"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2YR Rainfall=3.17"

Area (sf)	CN	Description
4,227	98	Roofs, HSG C
16,235	98	Unconnected pavement, HSG C
49,888	55	Woods, Good, HSG B
55,942	70	Woods, Good, HSG C
45,481	74	>75% Grass cover, Good, HSG C
171,773	70	Weighted Average, UI Adjusted CN = 69
151,311		88.09% Pervious Area
20,462		11.91% Impervious Area
16,235		79.34% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0100	0.11		**Sheet Flow, Grass** Grass: Short n= 0.150 P2= 3.17"
0.9	114	0.0200	2.12		**Shallow Concentrated Flow, Grass** Grassed Waterway Kv= 15.0 fps
2.4	594	0.0400	4.06		**Shallow Concentrated Flow, Roadside** Paved Kv= 20.3 fps
10.8	758	Total			

Summary for Subcatchment 2S: Southwest

Runoff = 1.14 cfs @ 12.68 hrs, Volume= 0.210 af, Depth> 0.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2YR Rainfall=3.17"

Area (sf)	CN	Description
216,630	55	Woods, Good, HSG B
108,414	70	Woods, Good, HSG C
325,044	60	Weighted Average
325,044		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.4	50	0.0100	0.05		**Sheet Flow, Woods** Woods: Light underbrush n= 0.400 P2= 3.17"
9.8	370	0.0160	0.63		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
4.1	311	0.0640	1.26		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
6.6	301	0.0230	0.76		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
36.9	1,032	Total			

Summary for Subcatchment 3S: Southeast

Runoff = 3.15 cfs @ 12.54 hrs, Volume= 0.440 af, Depth> 0.55"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2YR Rainfall=3.17"

Area (sf)	CN	Description
103,988	55	Woods, Good, HSG B
313,255	70	Woods, Good, HSG C
417,243	66	Weighted Average
417,243		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.4	50	0.0100	0.05		**Sheet Flow, Woods** Woods: Light underbrush n= 0.400 P2= 3.17"
9.5	405	0.0200	0.71		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
1.7	157	0.0900	1.50		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
4.3	92	0.0050	0.35		**Shallow Concentrated Flow, Brush** Woodland Kv= 5.0 fps
0.2	37	0.2700	2.60		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
32.1	741	Total			

Summary for Reach POA1: POINT OF ANALYSIS 1

Inflow Area = 3.943 ac, 11.91% Impervious, Inflow Depth > 0.68" for 2YR event
Inflow = 2.58 cfs @ 12.17 hrs, Volume= 0.225 af
Outflow = 2.58 cfs @ 12.17 hrs, Volume= 0.225 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach POA2: POA2

Inflow Area = 7.462 ac, 0.00% Impervious, Inflow Depth > 0.34" for 2YR event
Inflow = 1.14 cfs @ 12.68 hrs, Volume= 0.210 af
Outflow = 1.14 cfs @ 12.68 hrs, Volume= 0.210 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach POA3: POA3

Inflow Area = 9.579 ac, 0.00% Impervious, Inflow Depth > 0.55" for 2YR event
Inflow = 3.15 cfs @ 12.54 hrs, Volume= 0.440 af
Outflow = 3.15 cfs @ 12.54 hrs, Volume= 0.440 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Off Site Runoff Area=171,773 sf 11.91% Impervious Runoff Depth>1.70"
Flow Length=758' Tc=10.8 min UI Adjusted CN=69 Runoff=7.05 cfs 0.559 af

Subcatchment 2S: Southwest Runoff Area=325,044 sf 0.00% Impervious Runoff Depth>1.08"
Flow Length=1,032' Tc=36.9 min CN=60 Runoff=4.85 cfs 0.673 af

Subcatchment 3S: Southeast Runoff Area=417,243 sf 0.00% Impervious Runoff Depth>1.47"
Flow Length=741' Tc=32.1 min CN=66 Runoff=9.55 cfs 1.177 af

Reach POA1: POINT OF ANALYSIS 1 Inflow=7.05 cfs 0.559 af
Outflow=7.05 cfs 0.559 af

Reach POA2: POA2 Inflow=4.85 cfs 0.673 af
Outflow=4.85 cfs 0.673 af

Reach POA3: POA3 Inflow=9.55 cfs 1.177 af
Outflow=9.55 cfs 1.177 af

Total Runoff Area = 20.984 ac Runoff Volume = 2.409 af Average Runoff Depth = 1.38"
97.76% Pervious = 20.514 ac 2.24% Impervious = 0.470 ac

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Off Site Runoff Area=171,773 sf 11.91% Impervious Runoff Depth>2.64"
Flow Length=758' Tc=10.8 min UI Adjusted CN=69 Runoff=11.10 cfs 0.869 af

Subcatchment 2S: Southwest Runoff Area=325,044 sf 0.00% Impervious Runoff Depth>1.84"
Flow Length=1,032' Tc=36.9 min CN=60 Runoff=8.70 cfs 1.146 af

Subcatchment 3S: Southeast Runoff Area=417,243 sf 0.00% Impervious Runoff Depth>2.36"
Flow Length=741' Tc=32.1 min CN=66 Runoff=15.60 cfs 1.880 af

Reach POA1: POINT OF ANALYSIS 1 Inflow=11.10 cfs 0.869 af
Outflow=11.10 cfs 0.869 af

Reach POA2: POA2 Inflow=8.70 cfs 1.146 af
Outflow=8.70 cfs 1.146 af

Reach POA3: POA3 Inflow=15.60 cfs 1.880 af
Outflow=15.60 cfs 1.880 af

Total Runoff Area = 20.984 ac Runoff Volume = 3.894 af Average Runoff Depth = 2.23"
97.76% Pervious = 20.514 ac 2.24% Impervious = 0.470 ac

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Off Site Runoff Area=171,773 sf 11.91% Impervious Runoff Depth>3.61"
Flow Length=758' Tc=10.8 min UI Adjusted CN=69 Runoff=15.17 cfs 1.186 af

Subcatchment 2S: Southwest Runoff Area=325,044 sf 0.00% Impervious Runoff Depth>2.66"
Flow Length=1,032' Tc=36.9 min CN=60 Runoff=12.78 cfs 1.652 af

Subcatchment 3S: Southeast Runoff Area=417,243 sf 0.00% Impervious Runoff Depth>3.27"
Flow Length=741' Tc=32.1 min CN=66 Runoff=21.78 cfs 2.610 af

Reach POA1: POINT OF ANALYSIS 1 Inflow=15.17 cfs 1.186 af
Outflow=15.17 cfs 1.186 af

Reach POA2: POA2 Inflow=12.78 cfs 1.652 af
Outflow=12.78 cfs 1.652 af

Reach POA3: POA3 Inflow=21.78 cfs 2.610 af
Outflow=21.78 cfs 2.610 af

Total Runoff Area = 20.984 ac Runoff Volume = 5.448 af Average Runoff Depth = 3.12"
97.76% Pervious = 20.514 ac 2.24% Impervious = 0.470 ac

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Off Site Runoff Area=171,773 sf 11.91% Impervious Runoff Depth>4.84"
Flow Length=758' Tc=10.8 min UI Adjusted CN=69 Runoff=20.26 cfs 1.589 af

Subcatchment 2S: Southwest Runoff Area=325,044 sf 0.00% Impervious Runoff Depth>3.73"
Flow Length=1,032' Tc=36.9 min CN=60 Runoff=18.08 cfs 2.317 af

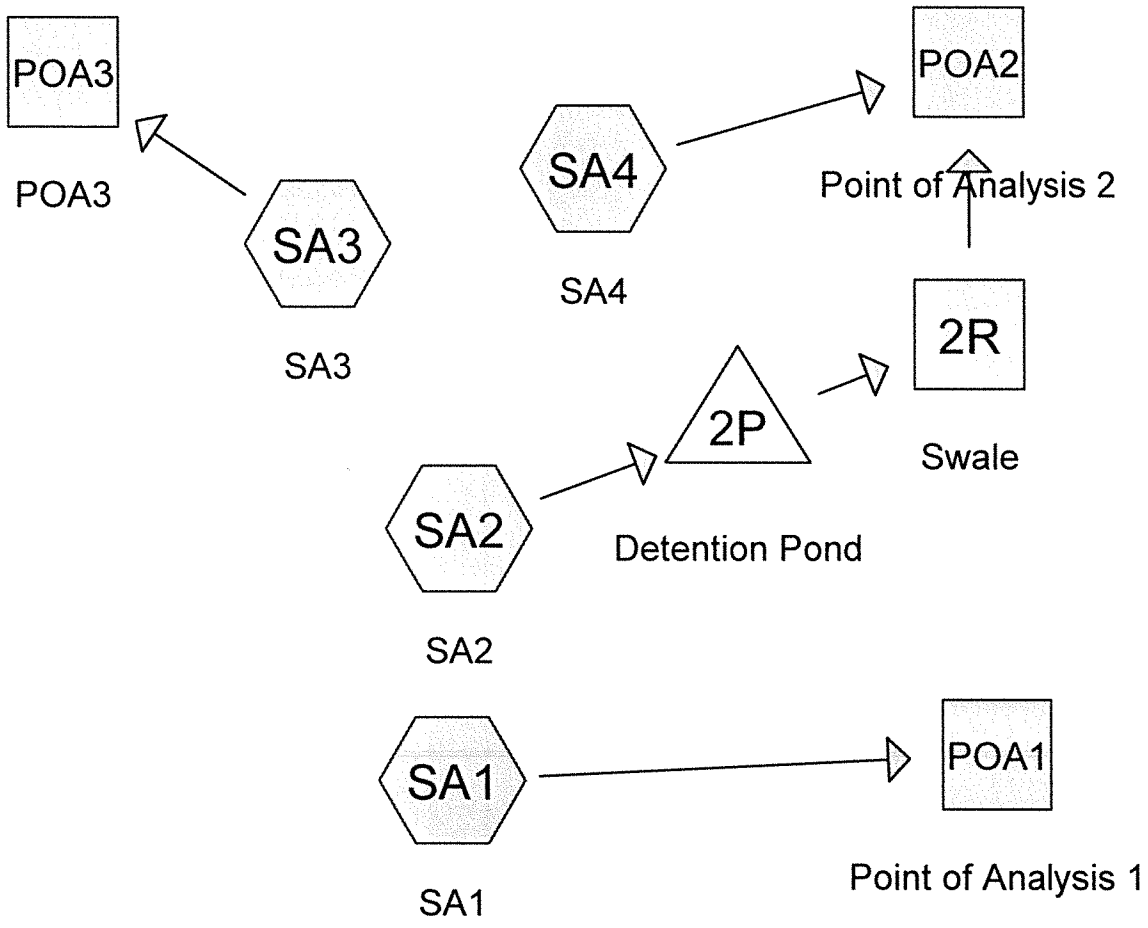
Subcatchment 3S: Southeast Runoff Area=417,243 sf 0.00% Impervious Runoff Depth>4.44"
Flow Length=741' Tc=32.1 min CN=66 Runoff=29.60 cfs 3.547 af

Reach POA1: POINT OF ANALYSIS 1 Inflow=20.26 cfs 1.589 af
Outflow=20.26 cfs 1.589 af

Reach POA2: POA2 Inflow=18.08 cfs 2.317 af
Outflow=18.08 cfs 2.317 af

Reach POA3: POA3 Inflow=29.60 cfs 3.547 af
Outflow=29.60 cfs 3.547 af

Total Runoff Area = 20.984 ac Runoff Volume = 7.454 af Average Runoff Depth = 4.26"
97.76% Pervious = 20.514 ac 2.24% Impervious = 0.470 ac



Subcat Reach Pond Link

Drainage Diagram for Post Dev

Prepared by Civil Construction Management, Inc., Printed 12/14/2023

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
5.772	55	Woods, Good, HSG B (SA1, SA3, SA4)
2.173	61	>75% Grass cover, Good, HSG B (SA1, SA2, SA3, SA4)
7.375	70	Woods, Good, HSG C (SA1, SA3)
0.911	73	Woods, Fair, HSG C (SA2)
3.130	74	>75% Grass cover, Good, HSG C (SA1, SA2, SA3, SA4)
0.147	85	Gravel roads, HSG B (SA2)
0.033	98	Paved roads, HSG C (SA4)
0.160	98	Roofs & Driveways HSG B (SA3, SA4)
0.062	98	Roofs & Driveways HSG C (SA3)
0.255	98	Roofs & Pavement HSG B (SA2)
0.332	98	Roofs & Pavement HSG C (SA2)
0.097	98	Roofs, HSG C (SA1)
0.537	98	Unconnected pavement, HSG C (SA1)
20.984		**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
8.506	HSG B	SA1, SA2, SA3, SA4
12.478	HSG C	SA1, SA2, SA3, SA4
0.000	HSG D	
0.000	Other	
20.984		**TOTAL AREA**

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment SA1: SA1 Runoff Area=155,699 sf 17.73% Impervious Runoff Depth>0.82"
Flow Length=984' Tc=12.1 min UI Adjusted CN=72 Runoff=2.83 cfs 0.245 af

Subcatchment SA2: SA2 Runoff Area=155,794 sf 16.42% Impervious Runoff Depth>1.07"
Flow Length=1,365' Tc=59.9 min CN=77 Runoff=1.90 cfs 0.318 af

Subcatchment SA3: SA3 Runoff Area=396,086 sf 1.08% Impervious Runoff Depth>0.59"
Flow Length=741' Tc=32.1 min CN=67 Runoff=3.28 cfs 0.448 af

Subcatchment SA4: SA4 Runoff Area=206,498 sf 3.31% Impervious Runoff Depth>0.28"
Flow Length=1,151' Tc=42.5 min CN=58 Runoff=0.50 cfs 0.109 af

Reach 2R: Swale Avg. Flow Depth=0.09' Max Vel=2.17 fps Inflow=0.83 cfs 0.304 af
n=0.010 L=400.0' S=0.0057 '/' Capacity=254.67 cfs Outflow=0.83 cfs 0.302 af

Reach POA1: Point of Analysis 1 Inflow=2.83 cfs 0.245 af
Outflow=2.83 cfs 0.245 af

Reach POA2: Point of Analysis 2 Inflow=1.12 cfs 0.411 af
Outflow=1.12 cfs 0.411 af

Reach POA3: POA3 Inflow=3.28 cfs 0.448 af
Outflow=3.28 cfs 0.448 af

Pond 2P: Detention Pond Peak Elev=126.23' Storage=4,513 cf Inflow=1.90 cfs 0.318 af
Outflow=0.83 cfs 0.304 af

Total Runoff Area = 20.984 ac Runoff Volume = 1.121 af Average Runoff Depth = 0.64"
92.96% Pervious = 19.508 ac 7.04% Impervious = 1.477 ac

Summary for Subcatchment SA1: SA1

Runoff = 2.83 cfs @ 12.19 hrs, Volume= 0.245 af, Depth> 0.82"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2yr Rainfall=3.17"

Area (sf)	CN	Description
4,227	98	Roofs, HSG C
23,385	98	Unconnected pavement, HSG C
10,144	61	>75% Grass cover, Good, HSG B
45,481	74	>75% Grass cover, Good, HSG C
15,763	55	Woods, Good, HSG B
56,699	70	Woods, Good, HSG C
155,699	74	Weighted Average, UI Adjusted CN = 72
128,087		82.27% Pervious Area
27,612		17.73% Impervious Area
23,385		84.69% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0100	0.11		**Sheet Flow, Grass** Grass: Short n= 0.150 P2= 3.17"
0.9	114	0.0200	2.12		**Shallow Concentrated Flow, Grass** Grassed Waterway Kv= 15.0 fps
2.4	594	0.0400	4.06		**Shallow Concentrated Flow, Roadside** Paved Kv= 20.3 fps
0.9	82	0.0100	1.50		**Shallow Concentrated Flow, Grass** Grassed Waterway Kv= 15.0 fps
0.4	144	0.0050	5.46	9.66	**Pipe Channel, Culverts** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.010 PVC, smooth interior
12.1	984	Total			

Summary for Subcatchment SA2: SA2

Runoff = 1.90 cfs @ 12.85 hrs, Volume= 0.318 af, Depth> 1.07"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2yr Rainfall=3.17"

	Area (sf)	CN	Description
*	11,118	98	Roofs & Pavement HSG B
*	14,469	98	Roofs & Pavement HSG C
	6,400	85	Gravel roads, HSG B
	10,762	61	>75% Grass cover, Good, HSG B
	73,370	74	>75% Grass cover, Good, HSG C
	39,675	73	Woods, Fair, HSG C
	155,794	77	Weighted Average
	130,207		83.58% Pervious Area
	25,587		16.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.9	50	0.0100	0.08		**Sheet Flow, Grass** Grass: Dense n= 0.240 P2= 3.17"
4.9	233	0.0250	0.79		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
2.1	186	0.0860	1.47		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
0.9	134	0.0300	2.60		**Shallow Concentrated Flow, Grass** Grassed Waterway Kv= 15.0 fps
7.8	460	0.0043	0.98		**Shallow Concentrated Flow, Grass** Grassed Waterway Kv= 15.0 fps
33.3	302	0.0033	0.15	0.26	**Trap/Vee/Rect Channel Flow, Grass** Bot.W=4.00' D=0.34' Z= 3.0 '/' Top.W=6.04' n= 0.240 Sheet flow over Dense Grass
59.9	1,365	Total			

Summary for Subcatchment SA3: SA3

Runoff = 3.28 cfs @ 12.53 hrs, Volume= 0.448 af, Depth> 0.59"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2yr Rainfall=3.17"

	Area (sf)	CN	Description
*	2,720	98	Roofs & Driveways HSG C
*	1,563	98	Roofs & Driveways HSG B
	15,232	61	>75% Grass cover, Good, HSG B
	16,649	74	>75% Grass cover, Good, HSG C
	95,345	55	Woods, Good, HSG B
	264,577	70	Woods, Good, HSG C
	396,086	67	Weighted Average
	391,803		98.92% Pervious Area
	4,283		1.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.4	50	0.0100	0.05		**Sheet Flow, Woods**
					Woods: Light underbrush n= 0.400 P2= 3.17"
9.5	405	0.0200	0.71		**Shallow Concentrated Flow, Woods**
					Woodland Kv= 5.0 fps
1.7	157	0.0900	1.50		**Shallow Concentrated Flow, Woods**
					Woodland Kv= 5.0 fps
4.3	92	0.0050	0.35		**Shallow Concentrated Flow, Brush**
					Woodland Kv= 5.0 fps
0.2	37	0.2700	2.60		**Shallow Concentrated Flow, Woods**
					Woodland Kv= 5.0 fps
32.1	741	Total			

Summary for Subcatchment SA4: SA4

Runoff = 0.50 cfs @ 12.81 hrs, Volume= 0.109 af, Depth> 0.28"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2yr Rainfall=3.17"

	Area (sf)	CN	Description
	140,311	55	Woods, Good, HSG B
*	5,397	98	Roofs & Driveways HSG B
*	1,442	98	Paved roads, HSG C
	58,506	61	>75% Grass cover, Good, HSG B
	842	74	>75% Grass cover, Good, HSG C
	206,498	58	Weighted Average
	199,659		96.69% Pervious Area
	6,839		3.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	24	0.0200	1.03		**Sheet Flow, Pavement**
					Smooth surfaces n= 0.011 P2= 3.17"
0.3	60	0.0600	3.67		**Shallow Concentrated Flow, Grass**
					Grassed Waterway Kv= 15.0 fps
2.7	380	0.0250	2.37		**Shallow Concentrated Flow, Grass**
					Grassed Waterway Kv= 15.0 fps
6.1	387	0.0050	1.06		**Shallow Concentrated Flow, Grass**
					Grassed Waterway Kv= 15.0 fps
33.0	300	0.0033	0.15	0.26	**Trap/Vee/Rect Channel Flow, Treatment swale**
					Bot.W=4.00' D=0.34' Z= 3.0 '/' Top.W=6.04'
					n= 0.240 Sheet flow over Dense Grass
42.5	1,151	Total			

Summary for Reach 2R: Swale

Inflow Area = 3.577 ac, 16.42% Impervious, Inflow Depth > 1.02" for 2yr event
Inflow = 0.83 cfs @ 13.71 hrs, Volume= 0.304 af
Outflow = 0.83 cfs @ 13.80 hrs, Volume= 0.302 af, Atten= 0%, Lag= 5.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.17 fps, Min. Travel Time= 3.1 min
Avg. Velocity = 1.55 fps, Avg. Travel Time= 4.3 min

Peak Storage= 153 cf @ 13.75 hrs
Average Depth at Peak Storage= 0.09'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 254.67 cfs

4.00' x 2.00' deep channel, n= 0.010 PVC, smooth interior
Side Slope Z-value= 3.0 '/' Top Width= 16.00'
Length= 400.0' Slope= 0.0057 '/'
Inlet Invert= 123.30', Outlet Invert= 121.00'

‡

Summary for Reach POA1: Point of Analysis 1

Inflow Area = 3.574 ac, 17.73% Impervious, Inflow Depth > 0.82" for 2yr event
Inflow = 2.83 cfs @ 12.19 hrs, Volume= 0.245 af
Outflow = 2.83 cfs @ 12.19 hrs, Volume= 0.245 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach POA2: Point of Analysis 2

Inflow Area = 8.317 ac, 8.95% Impervious, Inflow Depth > 0.59" for 2yr event
Inflow = 1.12 cfs @ 13.18 hrs, Volume= 0.411 af
Outflow = 1.12 cfs @ 13.18 hrs, Volume= 0.411 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach POA3: POA3

Inflow Area = 9.093 ac, 1.08% Impervious, Inflow Depth > 0.59" for 2yr event
Inflow = 3.28 cfs @ 12.53 hrs, Volume= 0.448 af
Outflow = 3.28 cfs @ 12.53 hrs, Volume= 0.448 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Pond 2P: Detention Pond

Inflow Area = 3.577 ac, 16.42% Impervious, Inflow Depth > 1.07" for 2yr event
Inflow = 1.90 cfs @ 12.85 hrs, Volume= 0.318 af
Outflow = 0.83 cfs @ 13.71 hrs, Volume= 0.304 af, Atten= 56%, Lag= 51.6 min
Primary = 0.83 cfs @ 13.71 hrs, Volume= 0.304 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 126.23' @ 13.71 hrs Surf.Area= 4,267 sf Storage= 4,513 cf

Plug-Flow detention time= 73.9 min calculated for 0.304 af (96% of inflow)
Center-of-Mass det. time= 60.0 min (912.5 - 852.6)

Volume	Invert	Avail.Storage	Storage Description
#1	125.00'	13,935 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
125.00	3,113	290.0	0	0	3,113
126.00	4,013	309.0	3,553	3,553	4,067
128.00	6,466	454.0	10,382	13,935	12,904

Device	Routing	Invert	Outlet Devices
#1	Primary	125.00'	**15.0" Round Culvert** L= 120.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 125.00' / 123.80' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior
#2	Device 1	125.00'	**6.0" W x 4.0" H Vert. Orifice/Grate** C= 0.600
#3	Device 1	126.25'	**18.0" W x 7.0" H Vert. Orifice/Grate** C= 0.600
#4	Device 1	126.85'	**46.0" W x 4.0" H Vert. Orifice/Grate** C= 0.600
#5	Primary	127.10'	**8.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.83 cfs @ 13.71 hrs HW=126.23' (Free Discharge)
- **1=Culvert** (Passes 0.83 cfs of 3.65 cfs potential flow)
  - **2=Orifice/Grate** (Orifice Controls 0.83 cfs @ 4.96 fps)
  - **3=Orifice/Grate** (Controls 0.00 cfs)
  - **4=Orifice/Grate** (Controls 0.00 cfs)
- **5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment SA1: SA1 Runoff Area=155,699 sf 17.73% Impervious Runoff Depth>1.92"
Flow Length=984' Tc=12.1 min UI Adjusted CN=72 Runoff=7.02 cfs 0.573 af

Subcatchment SA2: SA2 Runoff Area=155,794 sf 16.42% Impervious Runoff Depth>2.28"
Flow Length=1,365' Tc=59.9 min CN=77 Runoff=4.13 cfs 0.681 af

Subcatchment SA3: SA3 Runoff Area=396,086 sf 1.08% Impervious Runoff Depth>1.54"
Flow Length=741' Tc=32.1 min CN=67 Runoff=9.55 cfs 1.170 af

Subcatchment SA4: SA4 Runoff Area=206,498 sf 3.31% Impervious Runoff Depth>0.96"
Flow Length=1,151' Tc=42.5 min CN=58 Runoff=2.48 cfs 0.379 af

Reach 2R: Swale Avg. Flow Depth=0.20' Max Vel=3.53 fps Inflow=3.25 cfs 0.659 af
n=0.010 L=400.0' S=0.0057 '/' Capacity=254.67 cfs Outflow=3.25 cfs 0.656 af

Reach POA1: Point of Analysis 1 Inflow=7.02 cfs 0.573 af
Outflow=7.02 cfs 0.573 af

Reach POA2: Point of Analysis 2 Inflow=4.69 cfs 1.036 af
Outflow=4.69 cfs 1.036 af

Reach POA3: POA3 Inflow=9.55 cfs 1.170 af
Outflow=9.55 cfs 1.170 af

Pond 2P: Detention Pond Peak Elev=126.85' Storage=7,356 cf Inflow=4.13 cfs 0.681 af
Outflow=3.25 cfs 0.659 af

Total Runoff Area = 20.984 ac Runoff Volume = 2.803 af Average Runoff Depth = 1.60"
92.96% Pervious = 19.508 ac 7.04% Impervious = 1.477 ac

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment SA1: SA1 Runoff Area=155,699 sf 17.73% Impervious Runoff Depth>2.92"
Flow Length=984' Tc=12.1 min UI Adjusted CN=72 Runoff=10.72 cfs 0.870 af

Subcatchment SA2: SA2 Runoff Area=155,794 sf 16.42% Impervious Runoff Depth>3.35"
Flow Length=1,365' Tc=59.9 min CN=77 Runoff=6.02 cfs 0.997 af

Subcatchment SA3: SA3 Runoff Area=396,086 sf 1.08% Impervious Runoff Depth>2.44"
Flow Length=741' Tc=32.1 min CN=67 Runoff=15.39 cfs 1.851 af

Subcatchment SA4: SA4 Runoff Area=206,498 sf 3.31% Impervious Runoff Depth>1.68"
Flow Length=1,151' Tc=42.5 min CN=58 Runoff=4.63 cfs 0.662 af

Reach 2R: Swale Avg. Flow Depth=0.27' Max Vel=4.21 fps Inflow=5.51 cfs 0.964 af
n=0.010 L=400.0' S=0.0057 '/' Capacity=254.67 cfs Outflow=5.50 cfs 0.961 af

Reach POA1: Point of Analysis 1 Inflow=10.72 cfs 0.870 af
Outflow=10.72 cfs 0.870 af

Reach POA2: Point of Analysis 2 Inflow=8.70 cfs 1.624 af
Outflow=8.70 cfs 1.624 af

Reach POA3: POA3 Inflow=15.39 cfs 1.851 af
Outflow=15.39 cfs 1.851 af

Pond 2P: Detention Pond Peak Elev=127.08' Storage=8,562 cf Inflow=6.02 cfs 0.997 af
Outflow=5.51 cfs 0.964 af

Total Runoff Area = 20.984 ac Runoff Volume = 4.381 af Average Runoff Depth = 2.51"
92.96% Pervious = 19.508 ac 7.04% Impervious = 1.477 ac

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment SA1: SA1 Runoff Area=155,699 sf 17.73% Impervious Runoff Depth>3.93"
Flow Length=984' Tc=12.1 min UI Adjusted CN=72 Runoff=14.39 cfs 1.169 af

Subcatchment SA2: SA2 Runoff Area=155,794 sf 16.42% Impervious Runoff Depth>4.40"
Flow Length=1,365' Tc=59.9 min CN=77 Runoff=7.86 cfs 1.311 af

Subcatchment SA3: SA3 Runoff Area=396,086 sf 1.08% Impervious Runoff Depth>3.37"
Flow Length=741' Tc=32.1 min CN=67 Runoff=21.33 cfs 2.556 af

Subcatchment SA4: SA4 Runoff Area=206,498 sf 3.31% Impervious Runoff Depth>2.45"
Flow Length=1,151' Tc=42.5 min CN=58 Runoff=6.95 cfs 0.969 af

Reach 2R: Swale Avg. Flow Depth=0.32' Max Vel=4.65 fps Inflow=7.45 cfs 1.265 af
n=0.010 L=400.0' S=0.0057 '/' Capacity=254.67 cfs Outflow=7.42 cfs 1.262 af

Reach POA1: Point of Analysis 1 Inflow=14.39 cfs 1.169 af
Outflow=14.39 cfs 1.169 af

Reach POA2: Point of Analysis 2 Inflow=12.56 cfs 2.231 af
Outflow=12.56 cfs 2.231 af

Reach POA3: POA3 Inflow=21.33 cfs 2.556 af
Outflow=21.33 cfs 2.556 af

Pond 2P: Detention Pond Peak Elev=127.27' Storage=9,596 cf Inflow=7.86 cfs 1.311 af
Outflow=7.45 cfs 1.265 af

Total Runoff Area = 20.984 ac Runoff Volume = 6.006 af Average Runoff Depth = 3.43"
92.96% Pervious = 19.508 ac 7.04% Impervious = 1.477 ac

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment SA1: SA1 Runoff Area=155,699 sf 17.73% Impervious Runoff Depth>5.19"
Flow Length=984' Tc=12.1 min UI Adjusted CN=72 Runoff=18.92 cfs 1.547 af

Subcatchment SA2: SA2 Runoff Area=155,794 sf 16.42% Impervious Runoff Depth>5.71"
Flow Length=1,365' Tc=59.9 min CN=77 Runoff=10.11 cfs 1.702 af

Subcatchment SA3: SA3 Runoff Area=396,086 sf 1.08% Impervious Runoff Depth>4.56"
Flow Length=741' Tc=32.1 min CN=67 Runoff=28.83 cfs 3.457 af

Subcatchment SA4: SA4 Runoff Area=206,498 sf 3.31% Impervious Runoff Depth>3.48"
Flow Length=1,151' Tc=42.5 min CN=58 Runoff=10.00 cfs 1.377 af

Reach 2R: Swale Avg. Flow Depth=0.38' Max Vel=5.09 fps Inflow=9.88 cfs 1.640 af
n=0.010 L=400.0' S=0.0057 '/' Capacity=254.67 cfs Outflow=9.86 cfs 1.636 af

Reach POA1: Point of Analysis 1 Inflow=18.92 cfs 1.547 af
Outflow=18.92 cfs 1.547 af

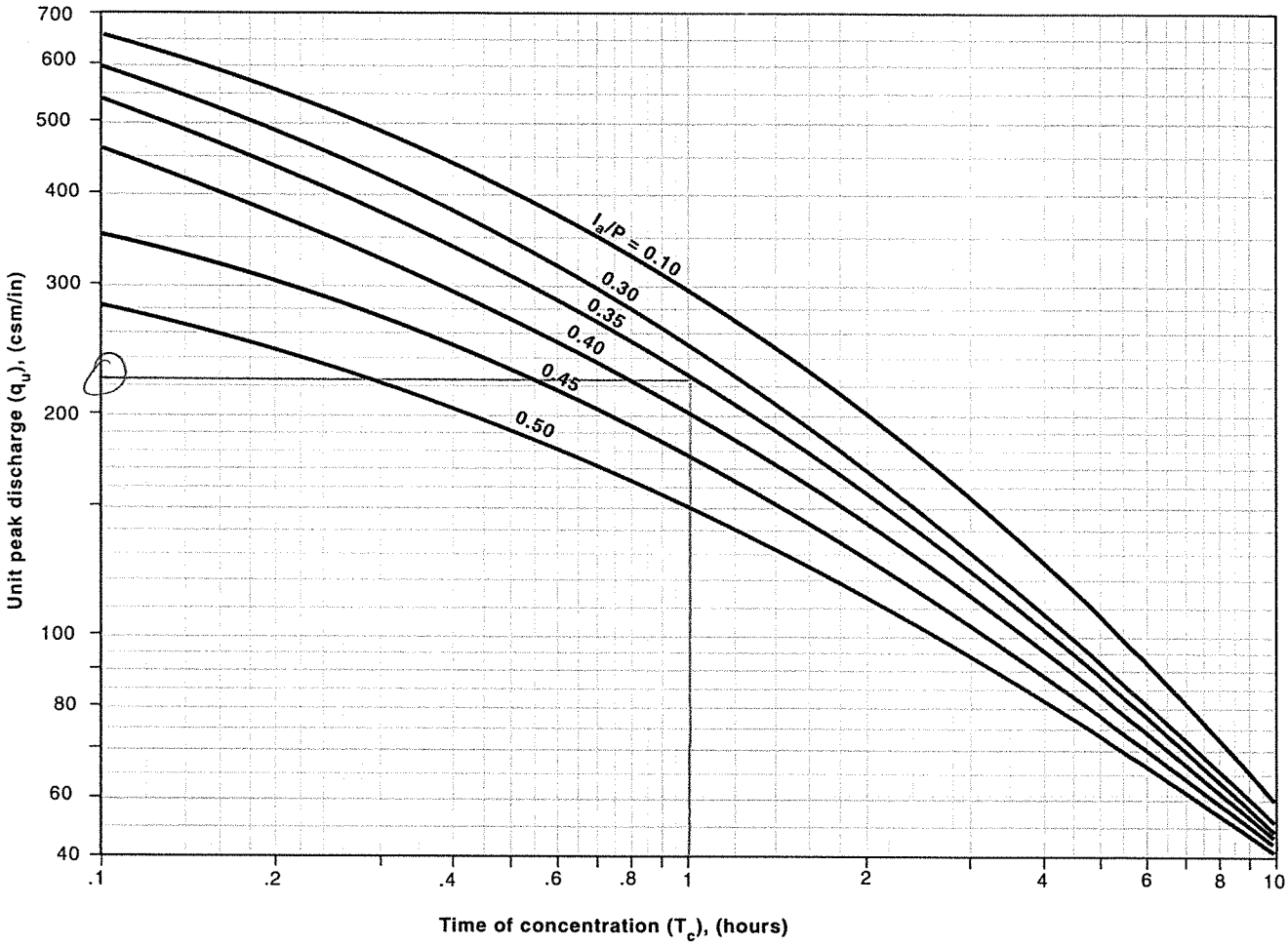
Reach POA2: Point of Analysis 2 Inflow=17.98 cfs 3.012 af
Outflow=17.98 cfs 3.012 af

Reach POA3: POA3 Inflow=28.83 cfs 3.457 af
Outflow=28.83 cfs 3.457 af

Pond 2P: Detention Pond Peak Elev=127.42' Storage=10,400 cf Inflow=10.11 cfs 1.702 af
Outflow=9.88 cfs 1.640 af

Total Runoff Area = 20.984 ac Runoff Volume = 8.083 af Average Runoff Depth = 4.62"
92.96% Pervious = 19.508 ac 7.04% Impervious = 1.477 ac

Exhibit 4-III Unit peal discharge (q_u) for NRCS (SCS) type III rainfall distribution



NEW HAMPSHIRE DEPARTMENT OF Environmental Services

STORMWATER POND DESIGN CRITERIA

Env-Wq 1508.03

Type/Node Name: **DETENTION BASIN AT BEL'S WAY, OFF NEW BOSTON ROAD, NEWTON**

Enter the type of stormwater pond (e.g., Wet Pond) and the node name in the drainage analysis, if applicable.

3.58	ac	A = Area draining to the practice	
0.58	ac	A_I = Impervious area draining to the practice	
0.16	decimal	I = Percent impervious area draining to the practice, in decimal form	
0.20	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)	
0.70	ac-in	WQV= 1" x Rv x A	
2,544	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")	
254	cf	10% x WQV (check calc for sediment forebay and micropool volume)	
1,272	cf	50% x WQV (check calc for extended detention volume)	
656	cf	V_{SED} = Sediment forebay volume	**≥ 10%WQV**
-	cf	V_{PP} = Permanent pool volume (volume below the lowest invert of the outlet structure) Attach stage-storage table.	
yes		Extended Detention?[1]	**≤ 50% WQV**
2,544	cf	V_{ED} = Volume of extended detention (if "yes" is given in box above)	
		E_{ED} = Elevation of WQV if "yes" is given in box above[2]	
0.06	cfs	$2Q_{avg}$ = 2* V_{ED} / 24 hrs * (1hr / 3600 sec) (used to check against Q_{EDmax} below)	
	cfs	Q_{EDmax} = Discharge at the E_{ED} (attach stage-discharge table)	**< $2Q_{avg}$**
-	hours	T_{ED} = Drawdown time of extended detention = $2V_{ED}/Q_{EDmax}$	**≥ 24-hrs**
3.00	:1	Pond side slopes	**≥3:1**
3.00	ft	Elevation of seasonal high water table	
125.00	ft	Elevation of lowest pond outlet	
-2.00	ft	Max floor = Maximum elevation of pond bottom (ft)	
-5.00	ft	Minimum floor (to maintain depth at less than 8')	**≤ 8 ft**
125.00	ft	Elevation of pond floor[3]	**≤ Max floor and > Min floor**
120.00	ft	Length of the flow path between the inlet and outlet at mid-depth	
30.00	ft	Average width ([average of the top width + average bottom width]/2)	
4.00	:1	Length to average width ratio	**≥ 3:1**
yes	Yes/No	Is the perimeter curvilinear.	**← Yes**
Yes	Yes/No	Are the inlet and outlet located as far apart as possible.	**← Yes**
yes	Yes/No	Is there a manually-controlled drain to dewater the pond over a 24hr period?	
If no state why:			
TRASH RACK		What mechanism is proposed to prevent the outlet structure from clogging (applicable for orifices/weirs with a dimension of <6")?	
127.27	ft	Peak elevation of the 50-year storm event	
128.00	ft	Berm elevation of the pond	
YES		50 peak elevation ≤ the berm elevation?	**←yes**

1. If the entire WQV is stored in the perm. pool, there is no extended det., and the following five lines do not apply.

2. This is the elevation of WQV **if** the hydrologic analysis is set up to include the permanent pool storage in the node description.

3. If the pond floor elevation is above the max floor elev., a hydrologic budget must be submitted to demonstrate that a minimum depth of 3 feet can be maintained. (First check whether a revised "lowest pond outlet" elev. will resolve the issue.)

Designer's Notes:

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

TREATMENT SWALE DESIGN CRITERIA
(Env-Wq 1508.08)

Node Name: TREATMENT SWALE DESIGN CRITERIA - BEL'S WAY SUBDIVISION

Enter the node name in the drainage analysis (e.g., reach TS 5), if applicable.

Y	Yes/No	Have you reviewed the restrictions on unlined swales outlined in Env-Wq 1508.08(a)?	
NO	Yes/No	Is the system lined? (required if not treated or if above SHWT)	
3.58	ac	A = Area draining to the practice	
0.58	ac	A_I = Impervious area draining to the practice	
59.9	minutes	T_c = Time of Concentration	
0.16	decimal	I = Percent impervious area draining to the practice, in decimal form	
0.20	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)	
0.70	ac-in	WQV= 1" x Rv x A	
2,544	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")	
1	inches	P = Amount of rainfall. For WQF in NH, P = 1".	
0.20	inches	D_{WQ} = Water quality depth. D_{WQ} = WQV/A	
86	unitless	CN = Unit peak discharge curve number. $CN = 1000/(10+5P+10Q-10*[Q^2 + 1.25*Q*P]^{0.5})$	
1.64	inches	S = Potential maximum retention. S = (1000/CN) - 10	
0.327	inches	Ia = initial abstraction. Ia = 0.2S	
220	$cfs/mi^2/in$	q_u = Unit peak discharge. Obtain this value from TR-55 exhibits 4-II and 4-III	
0.24	cfs	WQF = q_u x WQV. Conversion: to convert "$cfs/mi^2/in$ * ac-in" to "cfs" multiply by $1mi^2/640ac$	
400.00	feet	L = Swale length [1]	**≥ 100'**
4.00	feet	w = Bottom of the swale width [2]	**0 - 8 feet**
121.00	feet	E_{SHWT} = Elevation of SHWT. If none found, use the lowest elev. of test pit.	
122.00	feet	E_{BTM} = Elevation of the bottom of the practice	**≥ E_{SHWT}**
3.0	:1	SS_{RIGHT} = Right side slope	**≥3:1**
3.0	:1	SS_{LEFT} = Left side slope	**≥3:1**
0.005	ft/ft	S = Slope of swale in decimal form [3]	**0.005 - .05**
2.6	inches	d = Flow depth in swale at WQF (attach stage-discharge table)	**≤ 4"**
0.15	unitless	d must be < 4", therefore Manning's n = 0.15	
0.99	ft^2	Cross-sectional area check (assume trapezoidal channel)	
5.34	feet	Check wetted perimeter	
0.22	cfs	WQF_{check}. [4]	**WQF_{check} = WQF?**
-7%		Percent difference between WQF_{check} and WQF [4]	**+/- 10%**
27	minutes	HRT = hydraulic residence time during the WQF	**≥ 10 min**
122.20	ft	Peak elevation of the 10-year storm event [5]	
124.00	ft	Elevation of the top of the swale	
YES	Yes/No	10 peak elevation ≤ the top of swale	**← yes**

1. Any portion of the swale that is in a roadside ditch shall not count towards the swale length.
2. Widths up to 16' allowed if a dividing berm or structure is used such that neither width is more than 8'.
3. If > 0.02 (2%) then check dams are required. No additional detention time is credited for check dams.
4. The WQF_{check} & WQF should be near equal (within 10%) if you have selected the correct depth off the stage-
5. If the swale does not discharge the 50-year storm without overtopping, hydrologic routing of secondary discharge

Designer's Notes:

PIPE OUTLET PROTECTION APRON DESIGN
And
d_{50} RIPRAP SIZING

PROJECT NAME :	BEL'S WAY, NEWTON				
PROJECT # :	Outlet P1				
BY :	DQ		CHECKED BY :		
DATE :	12/14/2023	STORM:	25	DATE :	

DOWMSTREAM CHANNEL (OR SPREADER) HYDRAULICS			
Culvert Diameter (Do) =	18	Inches	
Peak Discharge Required =	6.50	cfs	
Channel Bottom Width =	6.0	Feet	**(3 x Do If outlet is to Flat Area)**
Hydraulic Gradient =	0.15000	Feet/Feet	(Est from Apron Outlet Depth to Pipe Outlet Depth)
Left Side Slope =	3.0	:1(h:v)	
Right Side Slope =	3.0	:1(h:v)	
Depth of Flow* =	0.320	Feet	
Manning's "n" =	0.0852	Please refer to Figure 7-52 of HANDBOOK	
Area =	2.23	Square Feet	
Wetted Perimeter =	8.02	Feet	
Hydraulic Radius =	0.28	Feet	
Top Width =	7.92	Feet	
Velocity =	2.88	Feet/Second	
Peak Discharge Calculated =	6.41	cfs	Q calc must approx = Q required
Qcalc - **Q**required =	-0.09	**Calculation OK**	

La AND W CALCULATIONS:

Culvert Diameter (Do) =	18.0	Inches
Tail Water Depth (TW)* =	0.32	Feet
Length of Apron (La) =	17	Feet
Width of Apron @ D.S End - (W) =	21	Feet
Width of D.S. Apron if Channel - (W) =	7.9	Feet

Assumes Channel Bottom at the Culvert Equals the Invert Outlet Elevation of the Pipe. If this is not the case, the calculations involving the Tailwater will have to be calculated by hand.

***If outletting to Flat Area use TW depth = 0.2 x Do**

ROCK RIPRAP SIZE

d_{50} = 0.51 Feet or 6.07 Inches

$d_{50} = (0.02 \times Q^{4/3})/(Tw \times Do)$

ROCK RIPRAP GRADATION (TABLE 7-24 OF NHDES HANDBOOK)

% of Weight Smaller Than The Given Size	Size of Stone in Inches		
100	----------	to	12.1
85	7.9	to	10.9
50	6.1	to	9.1
15	1.8	to	3.0

Minimum Rock Riprap Blanket Thickness = 18.2 Inches
Minimum Six inch Sand/Gravel Bedding or Geotextile Fabric Required Under All Rock Riprap

FORMULAS USED (Reference NHDES HANDBOOK, Pages 7-114, 7-115)

Manning's Uniform Channel Flow -	Q = (A x 1.486 x R^(2/3) x S^(1/2))/"n"
Length of Apron (La) TW< Do/2 -	La = (1.8 x Q/Do^1.5) + 7 x Do
Length of Apron (La) TW>= Do/2 -	La = 3.0 x Q/Do^1.5 + 7 x Do
Width of Apron @ D.S End TW < Do/2 -	W = 3 x Do + La
Width of Apron @ D.S End TW >= Do/2 -	W = 3 x Do + 0.4 x La
Width of D.S. Apron if in Channel -	Ch. BW +Sum of Side Slopes x Flow Depth
Width of Apron @ Culvert -	Wc = 3 x Do

PIPE OUTLET PROTECTION APRON DESIGN
And
d_{50} RIPRAP SIZING

PROJECT NAME :	BEL'S WAY, NEWTON				
PROJECT # :	Basin Outlet P2				
BY :	DQ			CHECKED BY :	
DATE :	12/14/2023	STORM:	25	DATE :	

DOWMSTREAM CHANNEL (OR SPREADER) HYDRAULICS

Culvert Diameter (Do) =	15	Inches	
Peak Discharge Required =	5.51	cfs	
Channel Bottom Width =	4.0	Feet	**(3 x Do If outlet is to Flat Area)**
Hydraulic Gradient =	0.01000	Feet/Feet	(Est from Apron Outlet Depth to Pipe Outlet Depth)
Left Side Slope =	3.0	:1(h:v)	
Right Side Slope =	3.0	:1(h:v)	
Depth of Flow* =	0.540	Feet	
Manning's "n" =	0.0454	Please refer to Figure 7-52 of HANDBOOK	
Area =	3.03	Square Feet	
Wetted Perimeter =	7.42	Feet	
Hydraulic Radius =	0.41	Feet	
Top Width =	7.24	Feet	
Velocity =	1.81	Feet/Second	
Peak Discharge Calculated =	5.48	cfs	Q calc must approx = Q required
Qcalc - Qrequired =	-0.03	**Calculation OK**	

La AND W CALCULATIONS:

Culvert Diameter (Do) =	15.0	Inches
Tail Water Depth (TW)* =	0.54	Feet
Length of Apron (La) =	16	Feet
Width of Apron @ D.S End - (W) =	20	Feet
Width of D.S. Apron if Channel - (W) =	7.2	Feet

Assumes Channel Bottom at the Culvert Equals the Invert Outlet Elevation of the Pipe. If this is not the case, the calculations involving the Tailwater will have to be calculated by hand.

***If outletting to Flat Area use TW depth = 0.2 x Do**

ROCK RIPRAP SIZE

d_{50} = 0.29 Feet or 3.46 Inches

$d_{50} = (0.02 \times Q^{4/3})/(Tw \times Do)$

ROCK RIPRAP GRADATION (TABLE 7-24 OF NHDES HANDBOOK)

% of Weight Smaller Than The Given Size	Size of Stone in Inches		
100	----------	to	6.9
85	4.5	to	6.2
50	3.5	to	5.2
15	1.0	to	1.7

Minimum Rock Riprap Blanket Thickness = 10.4 Inches
Minimum Six inch Sand/Gravel Bedding or Geotextile Fabric Required Under All Rock Riprap

FORMULAS USED (Reference NHDES HANDBOOK, Pages 7-114, 7-115)

Manning's Uniform Channel Flow -	Q = (A x 1.486 x R^(2/3) x S^(1/2))/"n"
Length of Apron (La) TW< Do/2 -	La = (1.8 x Q/Do^1.5) + 7 x Do
Length of Apron (La) TW>= Do/2 -	La = 3.0 x Q/Do^1.5 + 7 x Do
Width of Apron @ D.S End TW < Do/2 -	W = 3 x Do + La
Width of Apron @ D.S End TW >= Do/2 -	W = 3 x Do + 0.4 x La
Width of D.S. Apron if in Channel -	Ch. BW +Sum of Side Slopes x Flow Depth
Width of Apron @ Culvert -	Wc = 3 x Do

CCL 24 New Boston Road – Soil Test Pits
Logged 10-19-23 Witnessed by Mike Dorman

Test Pit 1
0-8" 10YR 3-4 Fine Sandy Loam, Granular, Very Friable,
8-20"10YR 4-4 Sandy Loam, Granular, Friable,
20-56" 2.5Y 6-6 Medium Sand, Massive, Loose,
56-86" 2.5Y6-4 Medium Sand, Massive, Loose.
ESWT 72" Groundwater 78"

Test Pit 2
0-10" 10YR 3-3 Fine Sandy Loam, Granular, Very Friable,
10-22"10YR 6-6 Sandy Loam, Granular, Friable,
22-70" 2.5Y 6-4 Medium Sand, Massive, Loose,
70-88" 2.5Y6-3 Medium Sand, Massive, Loose.
ESWT 78" Groundwater None

Test Pit 3
0-6" 10YR 3-4 Fine Sandy Loam, Granular, Very Friable,
6-18"10YR 5-6 Sandy Loam, Granular, Friable,
18-42" 7.5YR 5-6 Gravelly Sandy Loam, Granular, Friable,
42-64" Gley1-5/10 Shale Sandy Loam, Granular, Friable.
No Refusal ESWT 48" Groundwater None

Test Pit 4
0-3" 10YR 3-4 Fine Sandy Loam, Granular, Very Friable,
3-20"10YR 5-6 Gravelly Sandy Loam, Granular, Friable,
20-36" 7.5YR 5-6 Gravelly Sandy Loam, Granular, Friable,
36-52" Gley1-5/10 Shale Sandy Loam, Granular, Friable.
No Refusal ESWT 40" Groundwater None

Test Pit 5
0-3" 10YR 3-4 Fine Sandy Loam, Granular, Very Friable,
3-18"10YR 5-6 Sandy Loam, Granular, Friable,
18-36" 10YR 6-6 Gravelly Medium Sand, Massive, Loose,
36-56" 2.5Y 5-3 Gravelly Medium Sand, Massive, Loose.
No Refusal ESWT 48" Groundwater None

Test Pit 6
0-6" 10YR 3-4 Fine Sandy Loam, Granular, Very Friable,
6-20"10YR 5-6 Sandy Loam, Granular, Friable,
20-42" 2.5Y 6-6 Gravelly Medium Sand, Massive, Loose,
42-56" 2.5Y5-3 Gravelly Medium Sand, Massive, Loose.
No Refusal ESWT 48" Groundwater None

Test Pit 7
0-6" 10YR 3-4 Fine Sandy Loam, Granular, Very Friable,
6-22"10YR 5-6 Sandy Loam, Granular, Friable,
22-42" 2.5Y 6-6 Medium Sand, Massive, Loose,
42-84" 2.5Y6-4 Medium-Coarse Sand, Massive, Loose.
ESWT 72" Groundwater None

Test Pit 8
0-6" 10YR 3-4 Fine Sandy Loam, Granular, Very Friable,
6-20"10YR 5-6 Sandy Loam, Granular, Friable,
20-44" 2.5Y 6-4 Coarse Sand, Single Grained, Loose,
44-90" 2.5Y 7-4 Medium Sand, Massive, Loose.
ESWT 72+" Groundwater None

Test Pit 9
0-3" 10YR 3-3 Fine Sandy Loam, Granular, Very Friable,
3-14"10YR 5-6 Loamy Sand, Granular, Friable,
14-64" 2.5Y 6-6 Medium Sand, Massive, Loose,
64-76" 2.5Y 7-6 Medium Sand, Massive, Loose.
ESWT 74+" Groundwater None

Test Pit 10
0-3" 10YR 3-3 Fine Sandy Loam, Granular, Very Friable,
3-12"10YR 5-6 Loamy Sand, Granular, Friable,
12-32" 2.5Y 6-6 Medium Sand, Massive, Loose,
32-76" 2.5Y 7-6 Medium Sand, Massive, Loose.
ESWT 74+" Groundwater None

Test Pit 11
0-8" 10YR 3-3 Fine Sandy Loam, Granular, Very Friable,
8-15"10YR 5-6 Sandy Loam, Granular, Friable,
15-56" 2.5Y 6-6 Medium Sand, Massive, Loose,
56-70" 2.5Y6-3 Fine Sand, Massive, Friable.
ESWT 58" Groundwater 78"

Test Pit 12
0-8" 10YR 3-3 Fine Sandy Loam, Granular, Very Friable,
8-22"10YR 5-6 Loamy Sand, Granular, Friable,
22-56" 2.5Y 6-6 Medium-Coarse Sand, Massive, Loose,
56-78" 2.5Y 7-6 Fine Sand, Massive, Friable.
ESWT 74+" Groundwater None

Test Pit 13
0-8" 10YR 3-4 Fine Sandy Loam, Granular, Very Friable,
8-22"10YR 5-6 Loamy Sand, Granular, Friable,
22-42" 2.5Y 6-6 Medium Sand, Massive, Loose,
42-84" 2.5Y 7-6 Medium Sand, Massive, Loose.
ESWT 76" Groundwater 80"

Test Pit 14
0-8" 10YR 3-3 Fine Sandy Loam, Granular, Very Friable,
8-20"10YR 5-6 Sandy Loam, Granular, Friable,
20-70" 2.5Y 6-6 Medium Sand, Massive, Loose,
70-80" 2.5Y 6-3 Fine Sand, Granular, Friable.
ESWT 66" Groundwater 72"

Test Pit 15
0-8" 10YR 3-3 Fine Sandy Loam, Granular, Very Friable,
8-20"10YR 5-6 Sandy Loam, Granular, Friable,
20-44" 2.5Y 6-6 Medium Sand, Massive, Loose,
44-56" 2.5Y 6-4 Medium Sand, Massive, Loose.
ESWT 38" Groundwater 50"

Test Pit 16
0-8" 10YR 3-3 Fine Sandy Loam, Granular, Very Friable,
8-13"10YR 5-6 Sandy Loam, Granular, Friable,
13-36" 2.5Y 6-6 Medium Sand, Massive, Loose,
36-60" 2.5Y 6-3 Medium Sand, Massive, Loose.
ESWT 36" Groundwater 50"

Test Pit 17
0-8" 10YR 3-3 Fine Sandy Loam, Granular, Very Friable,
8-16"10YR 5-6 Sandy Loam, Granular, Friable,
16-36" 2.5Y 6-6 Medium Sand, Massive, Loose,
36-54" 2.5Y 6-4 Very Fine Sand, Massive, Friable.
ESWT 36" Groundwater 50"

STORMWATER MANAGEMENT OPERATION - INSPECTION AND MAINTENANCE MANUAL

BEL'S WAY

TAX MAP 3 BLOCK 1 LOT 12

RESIDENTIAL SUBDIVISION

NEW BOSTON ROAD
NEWTON, NH

DECEMBER 2023

by

CIVIL CONSTRUCTION MANAGEMENT, INC.
8 MERRIMAC ROAD
NEWTON, N.H. 03858
Tel. 603-382-7650

OVERVIEW

The intent of this plan is to provide the owner, and future property managers/owners of the site with a list of procedures that document the inspection and maintenance requirements of the Stormwater Management System for this development. This includes all temporary and permanent stormwater and erosion control measures during and post construction. This document outlines the O&M schedule necessary to ensure the long-term effectiveness of the approved stormwater management system.

Long-term inspections and maintenance are critical components for the success of the stormwater runoff erosion control Best Management Practices designed for this site. Additionally, the quality of surface water and groundwater can be maintained if certain source control measures are established. Source controls cover a wide range of management practices including fertilizer in landscaped areas, deicing of access ways in winter, and comprehensive snow removal. The guiding principles for pollution prevention and control are to minimize the volume of runoff and to minimize contact of stormwater with potential pollutants. Non-structural practices are an integral part of reducing stormwater pollutant loads and quantities.

Upon the completion of all terrain alteration activities that direct stormwater to a particular practice, the responsible party(ies) shall maintain the O&M activities.

RESPONSIBILITY

The current owners, its heirs, successors or assigns holds the responsibility for overseeing and implementing the O&M Plan and shall be responsible for the proper operation and maintenance of the stormwater systems. The approval of this project by the Town requires the creation of a Homeowner's Association (HOA). The documents which create the Association will state that upon assignment the Association will be responsible for the overall implementation of this manual and will include this manual as an exhibit. The Association documents shall include language that the Association's obligation for compliance with this O&M Manual cannot be amended or terminated except upon approval of the Town's Planning Board. The current owner, CCL HOLDINGS, LLC, shall remain responsible for the O&M activities until he notifies the Town of Newton the contact information for the newly established HOA.

The current owner, his heirs, successors or assigns, may contract with a third party(ies) to conduct the O&M activities, but shall remain responsible for ensuring the long-term effectiveness of the stormwater practices.

If a federal or state agency or a political subdivision of the state agrees to assume the responsibility for some or all components of the stormwater management system, the responsible party(ies) shall document the transfer of responsibility in writing to the Planning Department of the Town of Newton.

The current owners, its heirs, successors or assigns shall be open to working with the Town to achieve all stormwater goals promulgated by the EPA as they be applicable. Should ownership of the property change, the current owner(s) shall continue to be responsible until the succeeding owner(s) notifies the Town that said succeeding

owner(s) has assumed responsibility. Upon subsequent transfers, the responsibility shall continue to be that of the transferring owner until the transferee owner notifies the Town of the assumption of responsibility.

PROJECT INFORMATION AND RESPONSIBLE PARTY(IES)

Project Name:	BELL'S WAY Subdivision
NH-DES Subdivision #	Pending
NH-DES AoT #	N/A
Current Owner	CCL HOLDINGS, LLC
Homeowner's Assoc.	pending
Address:	24 New Boston Road, Newton, NH 03858
Phone #:	978-328-8972
e-mail:	Craig.comforthomes@gmail.com

Specific Responsibilities of Third Party

Name & address:	Same as above
Phone#:	
e-mail:	
Specific Responsibilities:	
Dates of responsibility:	

Specific Responsibilities of Third Party

Name & address:	
Phone#:	
e-mail:	
Specific Responsibilities:	
Dates of responsibility:	

SOURCE CONTROLS

Public Education:

Public Education can significantly reduce non-point pollution. All persons hired for the upkeep of the site, lawn care, landscaping, snow removal, and building maintenance etc. shall be informed about state regulations and local bylaws intended for controlling pollution and why the controls were instituted.

The following types of activities deserve special attention:

- Lawn and gardening activities, including pesticide and fertilizer application;
- Pet waste management, including pooper-scooper laws;
- Household chemical storage, use, and disposal, including automobile fluids, paints, pesticides, etc.; household hazardous waste collection and recycling programs help to increase public awareness;
- Other efforts, including water conservation and litter control.

BEST MANAGEMENT PRACTICES (BMP)

Regular inspections and maintenance are essential for long-term effectiveness of stormwater BMPs. BMPs are also very expensive to repair and replace. Sediment, trash, and other debris can accumulate in BMPs and needs to be removed periodically. If not properly maintained, the BMP will not operate as designed and will not provide effective treatment of stormwater runoff. This jeopardizes water quality and may violate permit conditions. All stormwater BMPs require maintenance, however, the frequency and difficulty of maintenance activities and the equipment needed to carry them out varies. Inspectors and those overseeing or performing maintenance should be well trained and thoroughly familiar with each BMP.

The following summarizes the relative level of maintenance required by each stormwater BMP located on this project site. Any inquiries in regards to the design, function, and/or maintenance of the following BMPs shall be directed to the Design Engineer (CCMI 603-382-7650).

Catch Basins:

- Catch basins may require frequent maintenance. Depending on location, this may require several cleanings of the sumps each year. At a minimum, it is recommended that catch basins be inspected at least twice annually, once following snow-melt and once following leaf-drop, and cleaned as indicated by inspection.
- Sediment shall be removed when it approaches half the sump depth.
- If floating hydrocarbons are observed during an inspection, the material should be removed immediately by skimming, absorbent materials, or approved other method.
- Removed sediment shall be tested and disposed of in compliance with all applicable state and federal regulations.

Detention Pond:

- The bottoms, interior and exterior side slopes, and crest of earthen stormwater ponds shall be mowed, and the vegetation maintained in healthy condition, as appropriate to the function of the facility and type of vegetation.
- Vegetated embankments that serve as "berms" or "dams" that impound water shall be mowed at least once annually to prevent the establishment of woody vegetation.
- Embankments shall be inspected at least annually by a qualified professional for settlement, erosion, seepage, animal burrows, woody vegetation, and other conditions that could degrade the embankment and reduce its stability for impounding water. Immediate corrective action shall be implemented if any such conditions are found.
- Inlet and outlet pipes, inlet and outlet structures, energy dissipation structures or practices, and other structural appurtenances shall be inspected at least annually by a qualified professional, and corrective action implemented (e.g., maintenance, repairs, or replacement) as indicated by such inspection.
- Trash and debris shall be removed from the basin and any inlet or outlet structures whenever observed by inspection.
- Accumulated sediment shall be removed when it significantly affects basin capacity.

Treatment Swale:

- Inspect annually (minimum) for erosion, sediment accumulation, vegetation loss, and presence of invasive species.
- Perform periodic mowing; frequency depends on location and type of grass. Do not cut shorter than Water Quality Flow depth (maximum 4-inches)
- Remove debris and accumulated sediment, based on inspection.
- Repair eroded areas, remove invasive species and dead vegetation, and reseed with applicable grass mix as warranted by inspection.

INVASIVE SPECIES ACTION PLAN:

All stormwater management practices shall be monitored for the presence of invasive species. If any invasive species begin to grow on the site, action shall be taken in accordance with "UNH Coop. Ext. Methods for disposing Non-Native Invasive Plants" (copy is included as part of this manual).

ANNUAL REPORT:

The Responsible Party shall conduct a yearly inspection and maintenance report by a qualified engineer. The report shall be submitted the first year and then every three years by September 1 of the reporting year and submitted to the Planning Office of the Town of Newton. The Association documents shall include language that the Association's obligation to provide this report cannot be amended or terminated except upon approval of the Town's Planning Board.

_____ _____

Current Owner Date
CCL HOLDINGS, LLC
85 Nassau Street
DRACUT, MA. 01826

_____ _____

Homeowner's Association Date
(pending)

This signature page shall be provided to the Raymond Planning Department upon the change of Ownership, Transfer or Assignment. Contact information is to remain updated and the responsibility of the applicable party responsible for this Operational and Maintenance Plan.

OPERATION & MAINTENANCE INSPECTION LOG

Activity or Structure	*Inspection Interval**	*Date Inspected*	*By*	*Action Taken*
Invasive Species	Annually			
Detention Pond				
Embankment	Annually			
(inspect and mow)				
Vegetation	Annually			
Inlet/Outlets	Annually and after every major storm event			
Sediment	Annually and after every major storm event			

*Inspect after <u>every</u> storm event with more than 2.5" of precipitation.

OPERATION & MAINTENANCE INSPECTION LOG

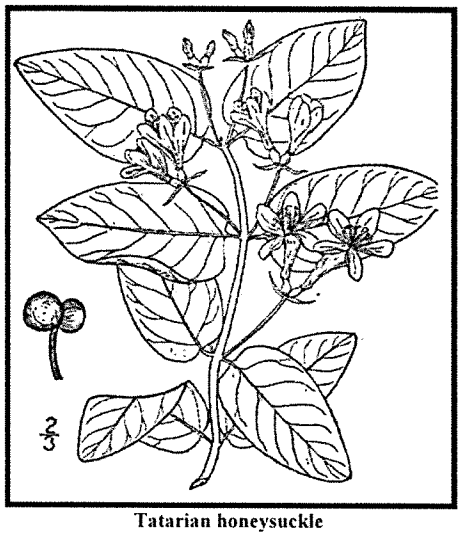
Activity or Structure	*Inspection Interval**	*Date Inspected*	*By*	*Action Taken*
Culverts & Swales				
Embankment	Annually			
Vegetation	Annually			
Inlet/Outlets	Annually and after every major storm event			
Sediment	after every major storm event			

*Inspect after <u>every</u> storm event with more than 2" of precipitation.

University of New Hampshire Cooperative Extension

Methods for Disposing Non-Native Invasive Plants

Prepared by the Invasives Species Outreach Group, volunteers interested in helping people control invasive plants. Assistance provided by the Piscataquog Land Conservancy and the NH Invasives Species Committee. Edited by Karen Bennett, Extension Forestry Professor and Specialist.



Tatarian honeysuckle
Lonicera tatarica
USDA-NRCS PLANTS Database / Britton, N.L., and A. Brown. 1913. *An illustrated flora of the northern United States, Canada and the British Possessions.* Vol. 3: 282.

Non-native invasive plants crowd out natives in natural and managed landscapes. They cost taxpayers billions of dollars each year from lost agricultural and forest crops, decreased biodiversity, impacts to natural resources and the environment, and the cost to control and eradicate them.

Invasive plants grow well even in less than desirable conditions such as sandy soils along roadsides, shaded wooded areas, and in wetlands. In ideal conditions, they grow and spread even faster. There are many ways to remove these non-native invasives, but once removed, care is needed to dispose the removed plant material so the plants don't grow where disposed.

Knowing how a particular plant reproduces indicates its method of spread and helps determine the appropriate disposal method. Most are spread by seed and are dispersed by wind, water, animals, or people. Some reproduce by vegetative means from pieces of stems or roots forming new plants. Others spread through both seed and vegetative means.

Because movement and disposal of viable plant parts is restricted (see NH Regulations), viable invasive parts can't be brought to most transfer stations in the state. Check with your transfer station to see if there is an approved, designated area for invasives disposal. This fact sheet gives recommendations for rendering plant parts non-viable.

Control of invasives is beyond the scope of this fact sheet. For information about control visit www.nhinvasives.org or contact your UNH Cooperative Extension office.

New Hampshire Regulations

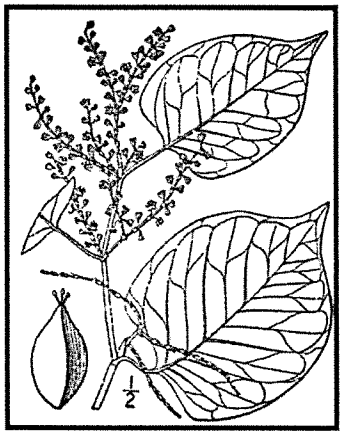
Prohibited invasive species shall only be disposed of in a manner that renders them nonliving and nonviable. (Agr. 3802.04)

No person shall collect, transport, import, export, move, buy, sell, distribute, propagate or transplant any living and viable portion of any plant species, which includes all of their cultivars and varieties, listed in Table 3800.1 of the New Hampshire prohibited invasive species list. (Agr 3802.01)

How and When to Dispose of Invasives?

To prevent seed from spreading remove invasive plants before seeds are set (produced). Some plants continue to grow, flower and set seed even after pulling or cutting. Seeds can remain viable in the ground for many years. If the plant has flowers or seeds, place the flowers and seeds in a heavy plastic bag "head first" at the weeding site and transport to the disposal site. The following are general descriptions of disposal methods. See the chart for recommendations by species.

Burning: Large woody branches and trunks can be used as firewood or burned in piles. For outside burning, a written fire permit from the local forest fire warden is required unless the ground is covered in snow. Brush larger than 5 inches in diameter can't be burned. Invasive plants with easily airborne seeds like black swallow-wort with mature seed pods (indicated by their brown color) shouldn't be burned as the seeds may disperse by the hot air created by the fire.



Japanese knotweed
Polygonum cuspidatum
USDA-NRCS PLANTS Database / Britton, N.L., and A. Brown. 1913. *An illustrated flora of the northern United States, Canada and the British Possessions*. Vol. I: 676.

Bagging (solarization): Use this technique with softer-tissue plants. Use heavy black or clear plastic bags (contractor grade), making sure that no parts of the plants poke through. Allow the bags to sit in the sun for several weeks and on dark pavement for the best effect.

Tarping and Drying: Pile material on a sheet of plastic and cover with a tarp, fastening the tarp to the ground and monitoring it for escapes. Let the material dry for several weeks, or until it is clearly nonviable.

Chipping: Use this method for woody plants that don't reproduce vegetatively.

Burying: This is risky, but can be done with watchful diligence. Lay thick plastic in a deep pit before placing the cut up plant material in the hole. Place the material away from the edge of the plastic before covering it with more heavy plastic. Eliminate as much air as possible and toss in soil to weight down the material in the pit. Note that the top of the buried material should be at least three feet underground. Japanese knotweed should be at least 5 feet underground!

Drowning: Fill a large barrel with water and place soft-tissue plants in the water. Check after a few weeks and look for rotted plant material (roots, stems, leaves, flowers). Well-rotted plant material may be composted. A word of caution- seeds may still be viable after using this method. Do this before seeds are set. This method isn't used often. Be prepared for an awful stink!

Composting: Invasive plants can take root in compost. Don't compost any invasives unless you know there is no viable (living) plant material left. Use one of the above techniques (bagging, tarping, drying, chipping, or drowning) to render the plants nonviable before composting. Closely examine the plant before composting and avoid composting seeds.

Be diligent looking for seedlings for *years* in areas where removal and disposal took place.

Suggested Disposal Methods for Non-Native Invasive Plants

This table provides information concerning the disposal of removed invasive plant material. If the infestation is treated with herbicide and left in place, these guidelines don't apply. Don't bring invasives to a local transfer station, unless there is a designated area for their disposal, or they have been rendered non-viable. This listing includes wetland and upland plants from the New Hampshire Prohibited Invasive Species List. The disposal of aquatic plants isn't addressed.

<table>
<tr><th>Woody Plants</th><th>Method of Reproducing</th><th>Methods of Disposal</th></tr>
<tr><td rowspan="2">Norway maple
(Acer platanoides)
European barberry
(Berberis vulgaris)
Japanese barberry
(Berberis thunbergii)
autumn olive
(Elaeagnus umbellata)
burning bush
(Euonymus alatus)
Morrow's honeysuckle
(Lonicera morrowii)
Tatarian honeysuckle
(Lonicera tatarica)
showy bush honeysuckle
(Lonicera x bella)
common buckthorn
(Rhamnus cathartica)
glossy buckthorn
(Frangula alnus)</td><td rowspan="2">Fruit and Seeds
  </td><td>Prior to fruit/seed ripening
Seedlings and small plants
▪ Pull or cut and leave on site with roots exposed. No special care needed.
Larger plants
▪ Use as firewood.
▪ Make a brush pile.
▪ Chip.
▪ Burn.</td></tr>
<tr><td>After fruit/seed is ripe
Don't remove from site.
▪ Burn.
▪ Make a covered brush pile.
▪ Chip once all fruit has dropped from branches.
▪ Leave resulting chips on site and monitor.</td></tr>
<tr><td rowspan="2">oriental bittersweet
(Celastrus orbiculatus)
multiflora rose
(Rosa multiflora)</td><td rowspan="2">Fruits, Seeds, Plant Fragments
  </td><td>Prior to fruit/seed ripening
Seedlings and small plants
▪ Pull or cut and leave on site with roots exposed. No special care needed.
Larger plants
▪ Make a brush pile.
▪ Burn.</td></tr>
<tr><td>After fruit/seed is ripe
Don't remove from site.
▪ Burn.
▪ Make a covered brush pile.
▪ Chip – only after material has fully dried (1 year) and all fruit has dropped from branches. Leave resulting chips on site and monitor.</td></tr>
</table>

<table>
<tr><th>Non-Woody Plants</th><th>Method of Reproducing</th><th>Methods of Disposal</th></tr>
<tr><td rowspan="2">garlic mustard
(Alliaria petiolata)
spotted knapweed
(Centaurea maculosa)
▪ Sap of related knapweed can cause skin irritation and tumors. Wear gloves when handling.
black swallow-wort
(Cynanchum nigrum)
▪ May cause skin rash. Wear gloves and long sleeves when handling.
pale swallow-wort
(Cynanchum rossicum)
giant hogweed
(Heracleum mantegazzianum)
▪ Can cause major skin rash. Wear gloves and long sleeves when handling.
dame's rocket
(Hesperis matronalis)
perennial pepperweed
(Lepidium latifolium)
purple loosestrife
(Lythrum salicaria)
Japanese stilt grass
(Microstegium vimineum)
mile-a-minute weed
(Polygonum perfoliatum)</td><td rowspan="2">Fruits and Seeds
  </td><td>Prior to flowering
Depends on scale of infestation
Small infestation
▪ Pull or cut plant and leave on site with roots exposed.

Large infestation
▪ Pull or cut plant and pile. (You can pile onto or cover with plastic sheeting).
▪ Monitor. Remove any re-sprouting material.</td></tr>
<tr><td>During and following flowering
Do nothing until the following year or remove flowering heads and bag and let rot.

Small infestation
▪ Pull or cut plant and leave on site with roots exposed.

Large infestation
▪ Pull or cut plant and pile remaining material. (You can pile onto plastic or cover with plastic sheeting).
▪ Monitor. Remove any re-sprouting material.</td></tr>
<tr><td>common reed
(Phragmites australis)
Japanese knotweed
(Polygonum cuspidatum)
Bohemian knotweed
(Polygonum x bohemicum)</td><td>Fruits, Seeds, Plant Fragments
Primary means of spread in these species is by plant parts. Although all care should be given to preventing the dispersal of seed during control activities, the presence of seed doesn't materially influence disposal activities.</td><td>Small infestation
▪ Bag all plant material and let rot.
▪ Never pile and use resulting material as compost.
▪ Burn.

Large infestation
▪ Remove material to unsuitable habitat (dry, hot and sunny or dry and shaded location) and scatter or pile.
▪ Monitor and remove any sprouting material.
▪ Pile, let dry, and burn.</td></tr>
</table>

January 2010